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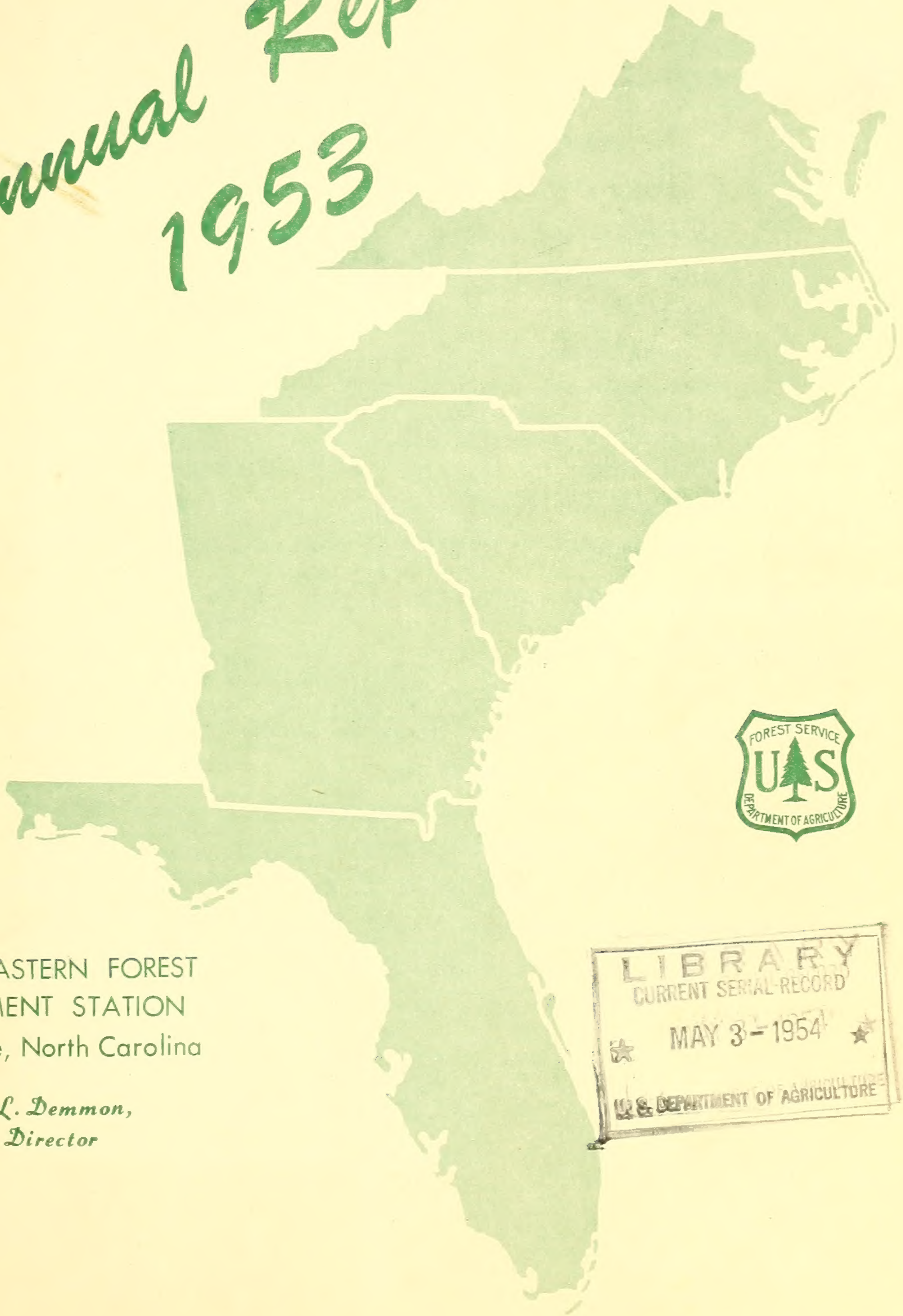
Annual Report 1953



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U.S. DEPARTMENT OF AGRICULTURE

SOUTHEASTERN FOREST
EXPERIMENT STATION
Asheville, North Carolina

E. L. Demmon,
Director

U. S. Department of Agriculture - Forest Service

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ANNUAL REPORT 1953

SOUTHEASTERN FOREST EXPERIMENT STATION

INTRODUCTION

Once again it is time for an Annual Report. What has the Station been doing in forest and range research during the past year? This booklet gives some of the highlights.

As a result of reorganizations in the Department of Agriculture, the Asheville Division of Forest Disease Investigations headed by George Hepting, which formerly operated under the Bureau of Plant Industry, Soils and Agricultural Engineering, was transferred at the end of 1953 to the Forest Service and is now an integral part of the Southeastern Station. The same holds true of the Asheville Division of Forest Insect Investigations headed by Charles F. Speers, formerly under the Bureau of Entomology and Plant Quarantine. In the past, Hepting and Speers and their men have cooperated with us so closely they were considered as part of the Station family. We now welcome them as full-fledged members and anticipate no dislocation of their work or their relations with the public.

An important trend in 1953 was greater emphasis on research in regeneration and genetics. This is in response to the tremendous increase in forest planting today and to the rising demand for better trees in the future. If all goes well, more than 400 million seedlings will be set out in the South in 1954; and naturally there is more insistence as time goes on that these seedlings should be the best obtainable. The Station made notable progress in this direction in 1953 as well as stimulated genetics research in other places. Fortunately, the Station has a start of more than 10 years based on its naval stores genetics work at Lake City. The State of Florida has sensed the importance of this research by allocating $20,000 a year for 2 years to the Station to speed up our genetics, regeneration, and silvicultural research. The Ida Cason Callaway Foundation, of Hamilton, Georgia, is also providing valuable assistance.

Thanks to substantial cooperation from four agencies named on page 5, long-needed research in Sandhill regeneration has been stepped up.

Our South Florida project, with headquarters now at Fort Myers, has been able to increase the size and scope of its research work because of a grant of $10,000 a year for 2 years from the Florida State Legislature, in addition to aid from the Atlantic Land and Improvement Company and the Collier Company. The problem there is to help put millions of idle or semi-idle acres to work and to figure out the best integration of forestry and forest grazing in the wide subtropical spaces just north of the Everglades.

The survey of forest resources in Georgia was completed in 1953 and one unit in North Carolina also finished. Several important forest grazing studies have been reported on in substantial bulletins. The motion picture "Waters of Coweeta," illustrating watershed management research in the Southern Appalachian Region has won distinction abroad and is in constant demand at home. Thousands of requests for information--more every year--pour in, and the Station issued over a hundred publications in 1953. All in all, it has been a productive year.

FOREST MANAGEMENT

From the Tidewater Research Center in Virginia to the Lake City Research Center in Florida, the field branches of the Station conduct practically all of its research in forest management. The Station attempts to see that this work is geared to the needs of local people, and that it is also properly coordinated for highest efficiency.

To keep its research center programs on the track of the major problems, the Station relies heavily on advisory committees for each of the seven research centers. These committees analyze trends in forestry currently and suggest the direction which future research should take.

Notable new developments in addition to the upsurge in planting and genetics are the use of improved machinery and chemicals in the culture of the forest, the increasing application of forest cropping practice to even poor forest lands and secondary forest types, and the increasing demand for knowledge of the management of good southern hardwoods. All of these trends enliven the researchers' race with time to find out how to grow the largest quantity of the best timber crops on the land area available.

REGENERATION

Continued high production of the pine industries in the Southeast depends on future supplies of pine timber. Unfortunately, much of the land from which the required pine trees are cut is left without sufficient seedlings or seed supply to maintain a productive pine forest. A resurvey of about 60 percent of the Station's territory (chiefly in the southern portion) indicates that hardwood types now dominate 29 percent of the area compared with 17 percent about 15 years ago. Planting is one solution to the maintenance of pine, but in many instances natural regeneration can be obtained if proper techniques are applied--often at small cost. In either case it is most important that we develop our knowledge to the point where successful regeneration can be assured. The Station's program includes regeneration studies for the major southern pines and also for some important minor species. Some progress is also being made on the problem of regenerating desirable hardwood species in view of their special importance to a number of primary and secondary forest industries.

Timing of Release Important in Cone Crop Stimulation

Timing of the cut has an important bearing on the amount of seed available for natural regeneration. Cutting in good seed years or immediately after the annual peak in seedfall usually assists regeneration. But now that we know seed production can be increased by release of seed trees in advance of cutting, time assumes even greater significance.

Last year's report of the Station explains that seed production of loblolly pine could be increased very significantly by crown release of the seed trees several years in advance of logging. Further information, portrayed in figure 1, shows that the timing of the release cutting determines whether the stimulated crop will be the third or fourth annual cone crop after cutting. In southeastern Virginia, for example, it is safe to count on an increase in the third succeeding cone crop if the trees are released before the end of May. Released trees continue to produce larger crops for at least 2 more years. There is therefore at least 3 years' leeway in the time when a fresh seedbed, created by logging, can be made to coincide with larger amounts of seeds.

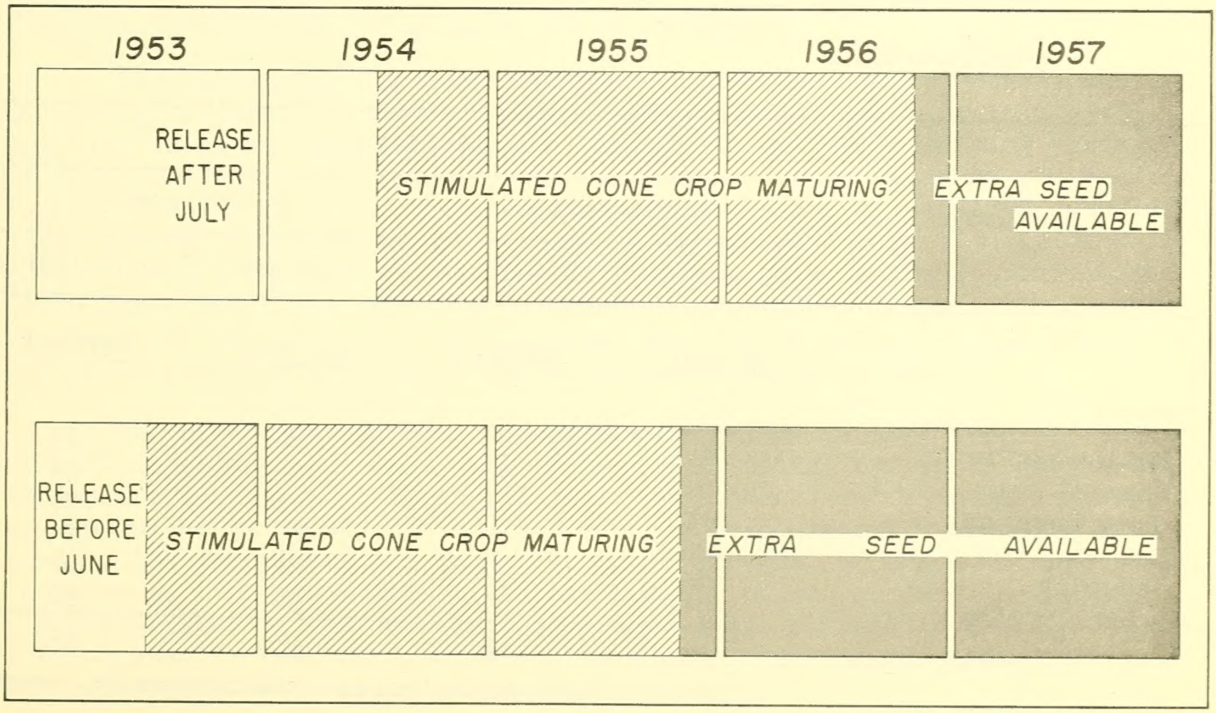


Figure 1.--Release before June, as compared with release after July, brings a stimulated seed crop one year earlier.

Correction Factor for Cone Crop Estimates

In loblolly pine, cone crop estimates can be made a year before the cones are due to ripen by counting conelets on sample trees cut on nearby logging operations. Initially, it was supposed that the cone crop could be estimated from the ratio of number of immature conelets to number of mature cones. Experimental forecasts made during the past 3 years in North Carolina and Virginia show that conelet count should be reduced by 45 percent in order to obtain a closer estimate of the future crop. This factor is needed to account for average losses of conelets before they mature.

First-Year Survival of Different Species Planted on Bottomlands

The increasing shortage of high-quality hardwood timber for the furniture and other industries in the Southeast has recently focussed attention on bottomland hardwoods. A large share of the bottomland areas is now in such condition that seeding or planting may be required to rehabilitate them. But knowledge concerning the artificial regeneration of hardwood bottoms is extremely limited. To increase information, a planting study was initiated in the South Carolina Coastal Plain during the winter of 1952-53. Six species were tested by planting 1-0 nursery-grown stock from local seed sources in fenced plots to exclude livestock. In addition, two species of oak were direct seeded. Results from the first installations are shown in table 1.

Table 1.--Survival after 1 year of various tree species planted or seeded on two bottomland hardwood sites on the Santee Experimental Forest, South Carolina

Species	Sites			
	First bottoms		Terraces	
	Cleared	Not cleared	Cleared	Not cleared
	Percent	Percent	Percent	Percent
Planted				
Yellow-poplar	21	21	84	99
Shumard oak	52	70	76	86
Cherrybark oak	64	76	76	77
Cow oak	74	79	86	84
Redcedar	26	32	81	92
Loblolly pine	78	81	94	90
All planting stock	50	58	82	88
Direct seeded				
Cherrybark oak	47	21	36	30
Shumard oak	30	37	78	31

Although not conclusive, these first-year results are at least indicative of some of the planting possibilities on bottomland hardwood sites. High water, particularly one flood before the growing season, caused most of the mortality in the first bottoms. All species did well on terrace sites, with yellow-poplar and loblolly pine outstanding. Somewhat better survival resulted on uncleared plots, indicating a temporary beneficial effect of cover during periods of drought. Rodents accounted for much of the loss in the acorn sowings, which had no screening or other protection.

Regeneration of South Florida Slash Pine

A unique problem in regeneration is provided by the 1,750,000 acres of south Florida slash pine (*Pinus elliottii* var. *densa*) in the subtropical portion of Florida. Over half of this area is denuded and will require artificial reforestation, but the results of past planting of south Florida slash pine have been unsatisfactory. Research on this problem was started by the Station in 1951, in cooperation with the Atlantic Land and Improvement Company, the Collier Company, and the Florida Forest Service.

Preliminary results show that seed losses are caused by cotton rats on the dry palmetto sites and by birds on the wet prairie sites, that nursery fertilization and lifting practice both have a noticeable effect on the survival of planted seedlings, and that the important problem in planting is to bring the seedlings through the first 5 or 6 months after winter planting. This is the critical drought period in the subtropical rainfall pattern of south Florida.

Planting and Seeding Studies Started in Sandhills

With an increasing scarcity of good pine land for purchase, the ownership of land for forest production is rapidly spreading to include anything which may produce timber. One of the largest remaining acreages of cheap land is to be found in the Sandhills or deep sands of the Coastal Plain. The big problem here is to convert extensive acreages of valueless scrub oak to pine. Research in Sandhill regeneration, previously very inadequate, is now getting under way in cooperation with the South Carolina State Forestry Commission, the Savannah River Project (Atomic Energy Commission), North Carolina State College, and the Division of Forestry of the North Carolina Department of Conservation and Development.

One of the new studies compared survival of planted longleaf pine by seedling grade, with and without needle clipping, by season of planting in major soil groups. The results have more than usual significance on account of an extremely dry and hot early growing season. Clipping of needles to approximately 5 inches improved survival of Grade 1 stock planted in January, but the treatment had no apparent effect on Grade 2 seedlings planted in January, or seedlings of either grade planted in March. Regardless of season, treatment, or seedling grade, planting on sandy loam was more successful than in the deep sands.

Longleaf direct seeding tests in the Sandhills show little promise of success so far. Unprotected sowings on the Savannah River Project area showed an 85 to 95-percent loss to rodents and birds. Protection with conical screens excluded birds, but up to one-half the seed was lost to rodents, even though the screens were pinned down with wire. A serious white grub problem encountered in the Savannah River plantations is discussed in the Forest Insect section page 52.

Regeneration Techniques for Sand Pine

Sand pine (Pinus clausa), a minor pine species, attains considerable local importance in Florida. On the Ocala National Forest alone, there are 210,000 acres of sand pine, comprising about 60 percent of the forest land. Sustained yield management on the Forest has been obstructed by the extreme difficulty of obtaining reproduction after cutting. Existing stands are largely the result of accidental fires followed by favorable temperature and moisture conditions. Cooperative investigations with the Ocala National Forest have been carried to the point where it is now possible to make at least interim recommendations for regenerating sand pine at the time of the harvest cut.

Sand pine stands which are cut over from July through December, and are tractor logged and skidded, should need no further treatment. Tracts which are cut over during this same July-December period, but are not tractor logged and skidded, should be scarified with a disk or brush-cutter about 1 to 2 months after cutting. Stands which are harvested in the January-June period should be scarified whenever the majority of the cones on the fallen tops open, but not later than December. Areas which fail to show satisfactory stocking 5 years after cutting should be interplanted with 1-1/2-year-old sand pine seedlings. November and December are the best planting months.

STAND IMPROVEMENT

Hardwood Competition Develops in 3 Years After Logging

The significance of early competition from low shrubs and hardwoods in the establishment of loblolly pine is well indicated from results of a study carried out in the Tidewater section of Virginia. This shows a rapid rate of increase of hardwood cover during the first 3 years after logging, followed by a marked slowing down thereafter. This suggests that the composition of the future stand is well established in 3 years. Therefore, the stocking of free seedlings at that time should be closely related to the eventual stocking of dominant loblolly pine, barring further cultural work.

Predicting Growth From Pine Seedling Characteristics

As an aid in determining the need for release of pine from competing vegetation, it was found that certain seedling measurements were an excellent clue to future height growth. Seven hundred 2- and 4-year-old loblolly seedlings measured in a North Carolina study revealed that (1) the ratio of height to diameter, (2) terminal bud length, (3) needle length, or (4) number of branches in descending order could be closely correlated with future height growth. For practical use it appears that number of branches will be the simplest to apply.

A related study of loblolly pine regeneration in shelterwood stands in the Georgia Piedmont showed that seedling growth and form quotient are closely related to stand density and shade level (fig. 2).

Estimating Area Shaded by Competing Hardwoods

Cultural measures to release pine seedlings are becoming so common that more precise estimates of the expected benefits are needed. The need for liberating pine seedlings, as well as the expected benefits from poisoning or girdling, can be judged quite accurately from the potential pine-growing area under the crowns of inferior species. A method of estimating the percent of area shaded by hardwoods 4 inches in diameter and larger has been developed from a study of residual hardwoods on cutover loblolly pine-hardwood tracts near Franklin, Va. Knowing the basal area of hardwoods per acre, an estimate of percent of area shaded can be obtained by multiplying basal area by 1.4. This is the area which a successful girdling or poisoning job would make available for pine.

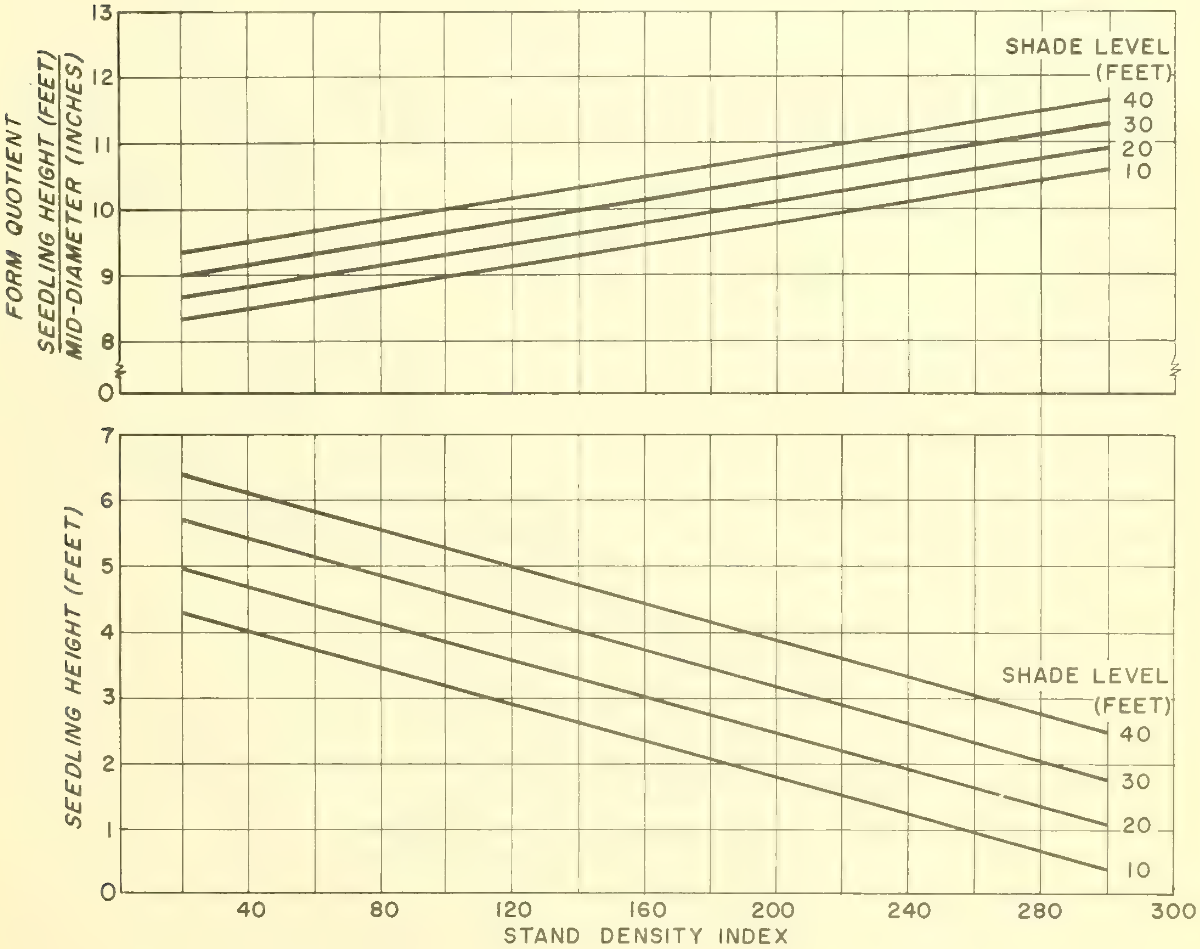


Figure 2.--Height and form quotient of 6-year-old pine seedlings under different pine overwood densities and levels of shade.

Recovery of seedlings liberated from larger competing stems is usually quite rapid (fig. 3). Even those which have been suppressed for long periods quickly build normal crowns and begin rapid height growth.

Estimating Man-Hours to Apply Ammate in Notches

Various methods of controlling inferior species retarding the establishment and growth of pine have been developed in the past several years. An important consideration is the time required to do such a job. Using a 3-man crew consisting of two axe men and one man to apply Ammate

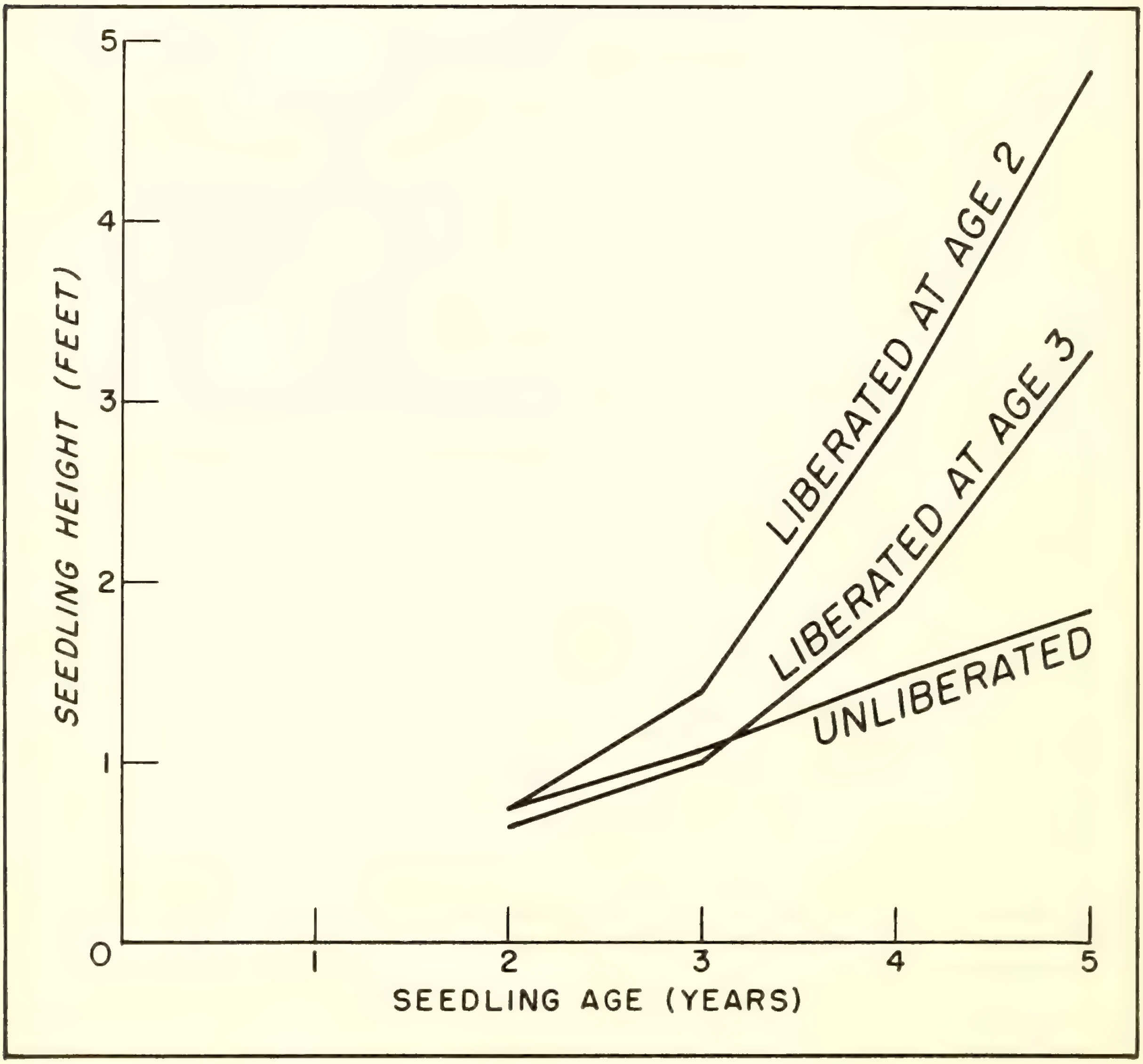


Figure 3.--Heights of loblolly pine seedlings 2 to 5 years old in the Bigwoods Experimental Forest with and without liberation from overstory hardwoods 4 inches and larger.

(ammonium sulfamate) in notches, the following equation was found to provide an accurate estimate of time required to treat pine-hardwood stands where the stems to be treated are mostly under 6 inches d.b.h.:

Man-hours per acre = 0.009(sum of the diameters)-0.005(number of stems)

This method of controlling inferior species requires about four pounds of ammate per 100 inches of diameter treated.

Poisoning With the Cornell Tool

Where low competition is a problem, there is need for an efficient but economical method of controlling small stems up to 3 inches in diameter which overtop pine. A promising treatment involves the use of the Cornell poisoning tool to apply Ammate in solution at the rate of 6 pounds to each gallon of water. The method of application is by incision or jabs around the basal perimeter--one jab per inch of diameter. In an experiment installed in January 1952 in coastal South Carolina 76 percent of the trees were killed or nearly killed within 1 year, resulting in effective release of seedling and sapling pine from competing gums, oaks, and myrtles.

Honeysuckle, an increasingly serious problem in the Piedmont, resists control. Preliminary tests on the Hitchiti Experimental Forest in Georgia involving 10 to 80 pounds of C.M.U. (chlorinated methyl urea) per acre, gave quick foliage kill but poor control of roots, particularly at lower rates of application.

FOREST GENETICS

The production of more and better forest products on the available land is the chief goal of forest management research in the Southeast. In the main, this involves the development of better cultural practices. But to get the most out of the land we also need better trees--superior strains of trees having improved growth rates, greater resistance to disease, better form, and higher quality. This job requires fundamental research, an intensive search for superior strains of trees, cross-pollination among superior individuals, and an extensive program of progeny testing.

The Station's genetics research was started at Lake City, Florida, in 1941. The genetics work as well as the other forest management research at Lake City was speeded up during 1953 by an appropriation of $20,000 from the State of Florida. Cooperation of the Station with the Ida Cason Callaway Foundation genetics project in Georgia was intensified, and several research centers initiated small genetics studies during the year.

Mature Cones Collected From Rooted Slash Pine Cuttings

Recently, at Lake City the project to develop high-yielding pine for gum naval stores made an important step ahead when mature cones were collected from 7-year-old rooted slash pine cuttings. This is the first recorded production of cones on slash pine cuttings. The initial milestone in this project was the rooting of cuttings from superior, mature trees in 1943-44, a feat never before accomplished. The largest planted cutting, now over 25 feet tall, is facetiously known at Lake City as "the most photographed tree in the world."

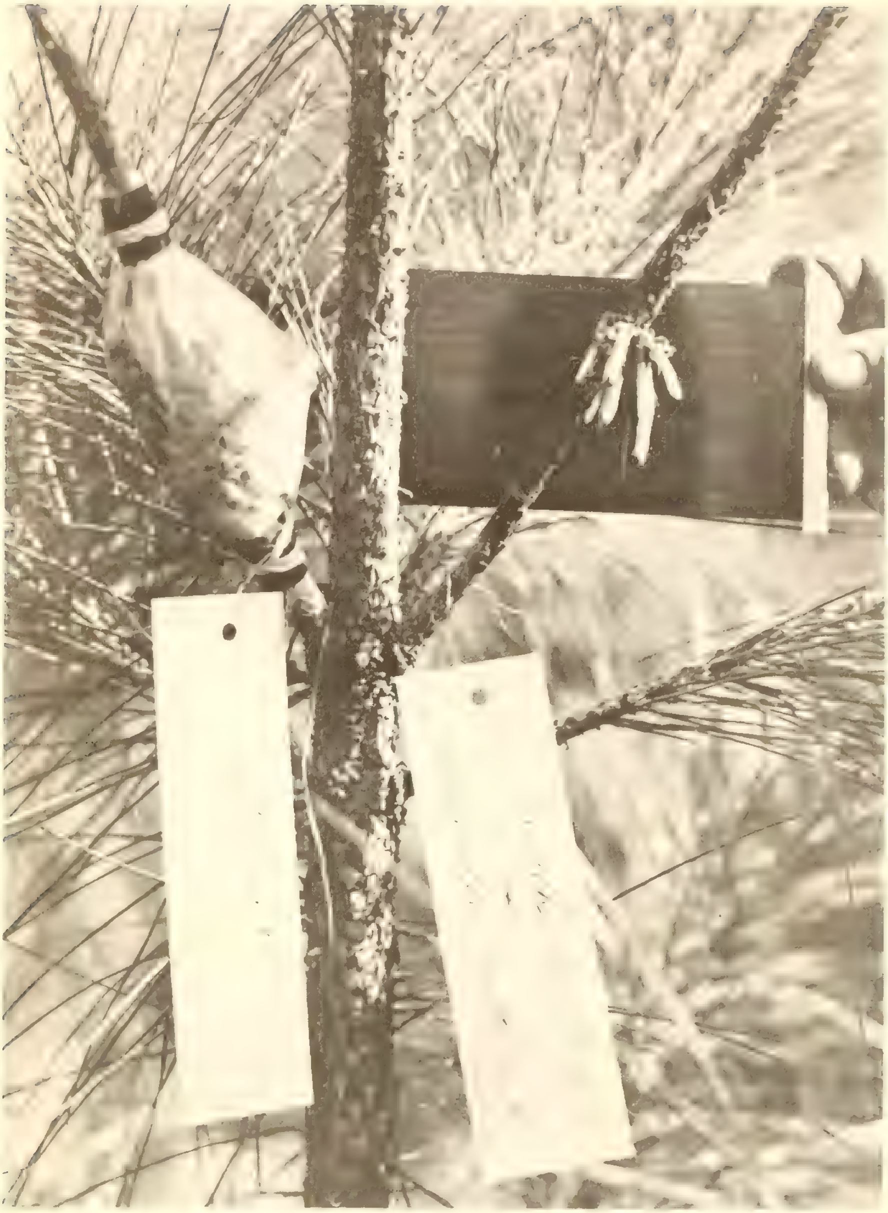


Figure 4.--Aerial roots on a slash pine branch after special treatment with a growth hormone. The treated area was wrapped in wet moss and covered with plastic for several weeks as shown on the twig at the left. This technique, called "air-layering," will facilitate the propagation of cuttings from "elite" trees.

Air-layering a Promising Technique for Slash Pine Rooting

It is a well established fact that propagation by vegetative means, such as rooting branch cuttings, assures progeny of the same characteristics as the parent. In an effort to develop more efficient propagation techniques for slash pine, intensive studies are under way at Olustee and Gainesville, Florida. Air-layering, an established technique in horticulture, has now been used with 85-percent success on slash pines 5 to 17 years old. The technique involves girdling a twig, painting the wound with a chemical growth substance, and binding wet moss about the wound with a plastic sheet that has been treated with nutrients and a fungicide. When roots appear (fig. 4), the twig is severed from the tree and planted in a nursery bed for further development.

Grafting Techniques for Slash Pine

Intensive studies have been conducted at Lake City to develop improved vegetative propagation techniques for slash pine for use in the genetics project. As shown in the following table, the bottle graft method gave 75-percent success in the greenhouse and 95-percent success in the field, where scions were grafted to natural seedlings under the partial shade of a pine stand.

Table 2.--Proportion of successful graft unions of slash pine in relation to grafting method and environment

(In percent)

Grafting method	In greenhouse		In pine stand	
	No cover	In sweatbox	No cover	In humidity chamber
Cleft	20	30	0	5
Veneer	30	55	0	45
Bottle	75	25	95	55

Inasmuch as the bottle method supplies water to the base of the scion from a small container, this method requires no humidity chamber. With veneer and cleft grafts, a humidity chamber is beneficial because it reduces the drying out of the graft union caused by transpiration drain on the scion.

Grafting of one species on another has been used as a shock treatment to induce early flowering of trees and thereby save years between generations in tree-breeding research. Such heteroplastic grafts have been made successfully at Lake City with scions of slash pine on stocks of loblolly, ponderosa, pitch, and white pines, Douglas-fir, Norway spruce, and white spruce. It is too soon to tell whether early seed production will follow.

Superior Trees Producing Superior Offspring

The cooperative tree improvement program with the Callaway Foundation, established in 1950 in the Georgia Piedmont, now has 30 acres of outplantings for testing longleaf, slash, shortleaf, and loblolly pine progeny from wind-pollinated superior mother trees. Distinct differences in height growth are apparent. For example, the seedlings from one parent tree of loblolly pine averaged more than twice as tall as the seedlings from another loblolly pine at 1 year of age.

The first seedlings from controlled-pollination of superior loblolly and slash pine phenotypes were produced in 1953. In each of three groups (two loblolly x loblolly and one loblolly x slash) control-pollinated year-old seedlings averaged taller than the more vigorous wind-pollinated group from either parent.

Good Results With Hybrid Poplar

A small test of hybrid poplars at the Coweeta and Toccoa Experimental Forests indicates that on good sites in the Southern Appalachians the hybrids show better growth than outstanding native species. Best results came from a hybrid clone designated Androscoggin (*Populus maximowiczii* x *P. berolinenis*). In 13 years, survival averaged 76 percent, height 46 feet, and diameter 4.7 inches.

Station Cooperating in Seed-Source Study

Several of the 50 plantations in the large cooperative seed-source study of the Committee on Southern Forest Tree Improvement were established by the Station's research centers. One at Lake City on land made available for genetics studies by the National Container Corporation reveals that seedlings from the southernmost seed origin of slash pine (Polk County, Florida) grow appreciably slower than seedlings from more northerly origins. These seedlings may be hybrids between north and south Florida slash pines.

Supplemental local seed source studies have been started, one in the south Georgia-north Florida area testing slash pine, and another in South Carolina for longleaf pine.

Introduced Species in Appalachian Mountains

Existing plantations containing introduced species often yield information regarding the adaptability of the species to a given area. One group of such plantations is at the Bent Creek Experimental Forest. Currently 32 species are involved, but only 10 species approach Southern Appalachian mountain native species in vigor and growth. Of these, only three show promise for further planting. Atlantic white-cedar grew well on a wet site, but was very susceptible to root and butt rot. Loblolly and pond pine were superior to all others in growth rate to date, even though they may not be climatically adapted to the area. Growth rates of the species tested are given in Station Paper 27.

PRUNING

Bud Pruning of Slash and Loblolly Pine

Bud pruning is a special technique requiring annual removal of all lateral buds or new branchlets. At the Hitchiti Experimental Forest in a test with slash pine, seven prunings have resulted in a significant reduction in height and diameter growth. This amounts to about 3-1/2 feet in height (in 6 years) and 0.25 inch in diameter (in 4 years). The seven annual prunings have now cleared one 16-foot log on 87 percent of the trees. Total time for each bud pruning to date amounted to 6 to 8 minutes per tree.

In loblolly there is also a reduction in growth from bud pruning. More serious than this is the occurrence of epicormic sprouting. About 95 percent of the pruned trees average about five sprouts per tree, a factor which increases pruning time and prevents development of a clear stem.

THINNING

Longleaf Pine

Comparatively little effort has been devoted to the problem of thinning for optimum stand density in the longleaf stands of the Southeast. A recently summarized study involving 22 quarter-acre plots established in 1932 in Florida is indicative of some of the basic relationships between stand density and growth rate per acre and per tree. The results obtained show that maximum volume production of flatwoods longleaf pine is possible over a wide range of stand densities, but that diameter growth and crown development is distinctly favored by light density. The data further show that where fairly wide spacing is used, such as to favor gum yields and forage production, the sacrifice of wood volume production of longleaf pine on poor flatwoods sites may be less than is generally supposed. Also, in view of an early expression of dominance which characterizes the species, precommercial thinnings do not appear to be justified.

White Pine

Were it not for the pioneering efforts in forestry on the Biltmore Estate, information on the management of Appalachian white pine plantations would be several decades in the future. Results are now available showing the effect of six thinnings (1916 to 1953) in a white pine plantation 53 years after planting, or 56 years from seed (fig. 5). Plot studies show

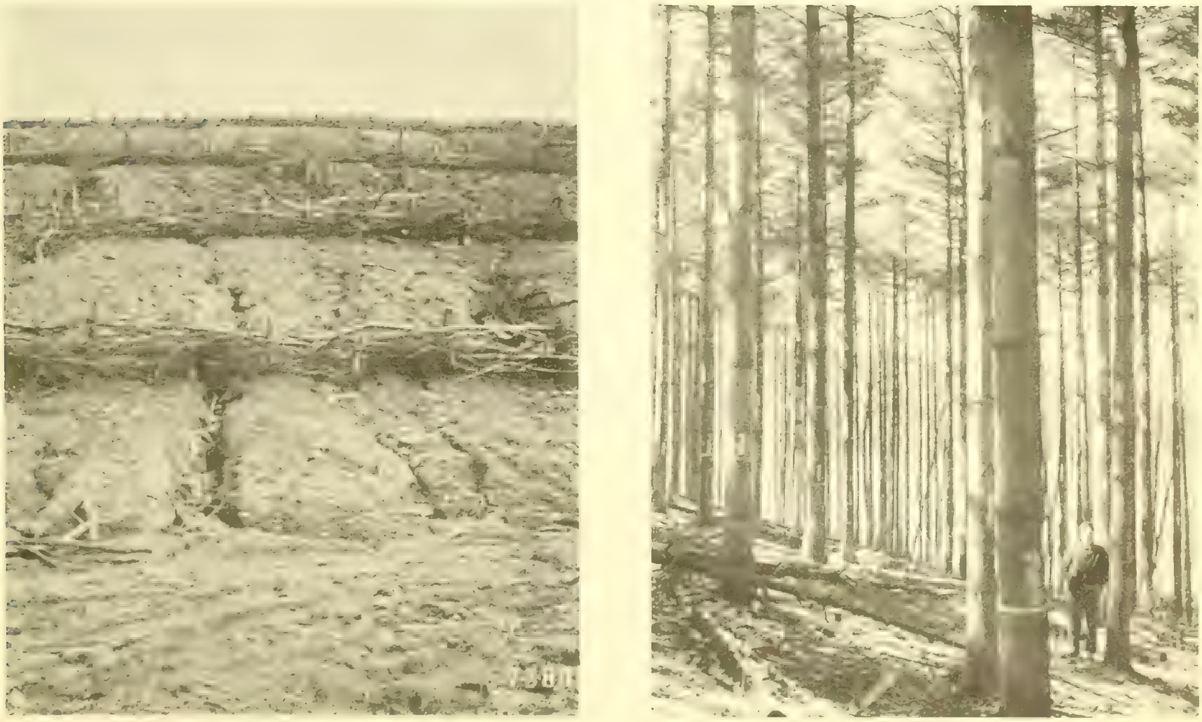


Figure 5.--Eroded hillside where pines were planted in 1899, and stand 48 years later.

that management in the form of these six intermediate cuttings has increased the total yield of the stand by $200 per acre in terms of stumpage value (fig. 6). Furthermore, nearly one-third of the total wood yield to date on the thinned area was obtained from the intermediate cuttings, which removed largely trees that will die without management (fig. 7). Sawtimber yields are 50 percent greater as a result of the thinning, and cubic-foot yields are 35 percent greater.

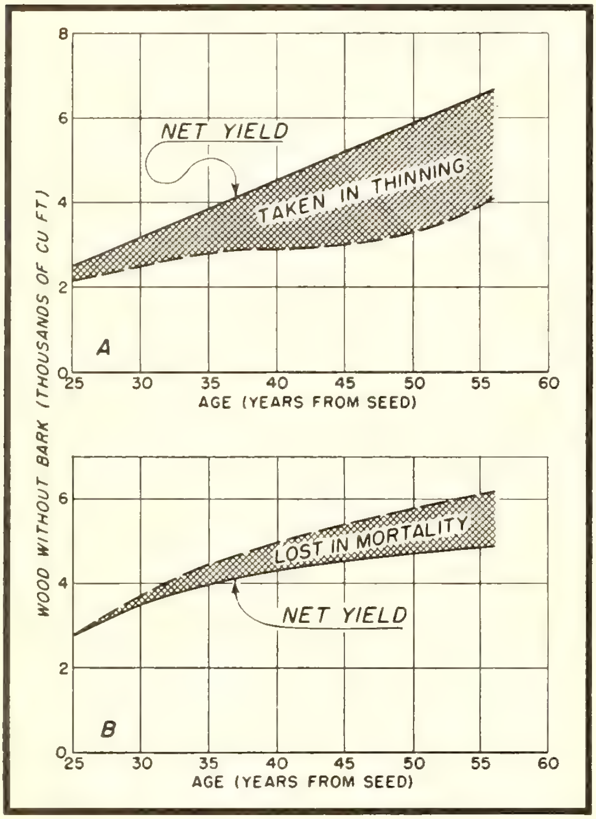


Figure 6.--Per-acre wood production in both saw logs and pulpwood as related to age. A thinned stand, and B unthinned.

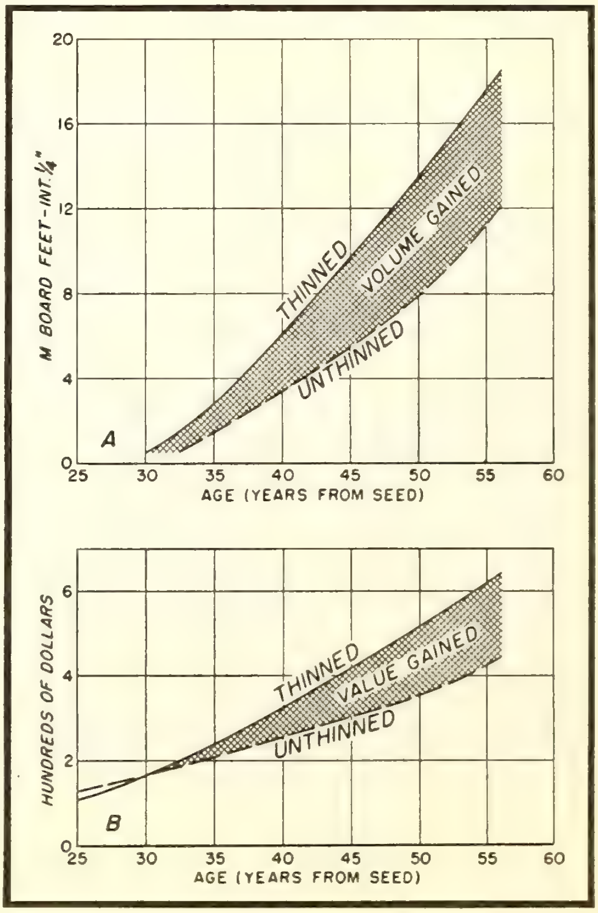


Figure 7.--A shows per-acre production in volume of saw logs only, and B shows value of both saw logs and pulpwood.

CUTTING METHODS

Methods of Cutting in Pine Pulpwood Stands

Loblolly pine pulpwood stands are usually ready for their first commercial cut at 25 to 30 years of age. Many are cut with no regard for their future potentialities; others are cut under a definite plan of management. A study of the economic and silvicultural aspects of six different methods of cutting was initiated in 1939 on five parallel sets of plots in Virginia and the Carolinas. A comparative analysis between methods was made 9 years later. Cutting methods used and the financial comparisons among them are shown in table 3.

Table 3.--Financial comparisons for a 9-year period after application of six methods of cutting in young loblolly pine stands

(Dollars per acre)

Method of cutting	Pulpwood value[1] 1939		Stand value 9 years later[1]		Expectation value 1939[2]	
	Cut	Left	As pulpwood	As sawtimber & pulpwood	As pulpwood	As sawtimber & pulpwood
4 seed trees	96	5	13	33	106	121
12 seed trees	92	9	22	60	109	138
Shelterwood (40 trees)	77	27	48	159	114	199
7-in. diameter limit	79	24	33	33	104	104
Moderate thinning from below	42	56	93	196	113	192
Heavy thinning from below	54	51	82	231	117	231

[1] Pulpwood stumpage $4.00 per standard rough cord. Sawtimber stumpage $30 per M bd. ft. (Int. 1/4-inch rule).

[2] "Expectation value 1939" is value of volume removed in 1939 plus value of residual stand 9 years later discounted at 3 percent.

The heavy thinning made the best financial showing on the basis of expectation value 1939. The average stand in this treatment group had a value of 105 dollars for pulpwood at 25 to 30 years of age. Half of this stand, left after thinning, increased to a value of $231 for sawtimber and pulpwood 9 years later. One of the heavily thinned stands is shown in figure 8.

Another major finding of the study was the failure of the seed-tree and other harvest cutting methods to regenerate the young stands that were cut at 25 to 30 years of age. Even 12 seed trees, the most successful of

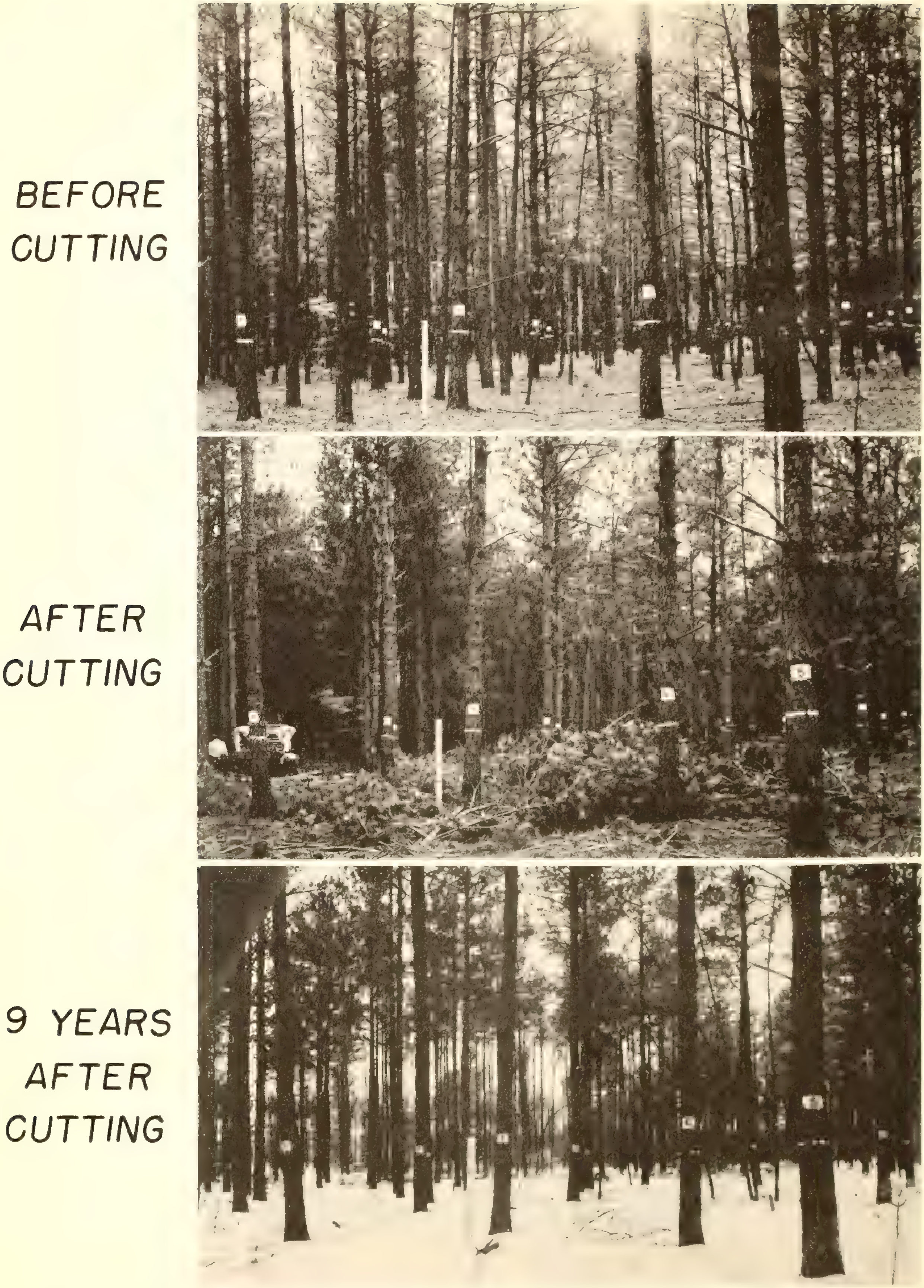


Figure 8.--A 27-year-old pine stand given a heavy thinning where all merchantable trees except 100 of the best dominants and codominants per acre were cut. Trees with number and band represent residual stand. This method of cutting produced the best volume growth and gross returns. Plot located near Jarratt, Va.

the methods tried, resulted in an average of only 360 pine seedlings per acre 3 years after the harvest. This study illustrates the difficulties to be expected when young loblolly pine stands are harvested before the trees are sufficiently well developed to provide adequate seed, and when no cultural measures are used to prepare a seedbed or control hardwood competition.

Clear Cutting Raises Water Level in Flatwoods

Of considerable concern to research workers in the lower Coastal Plain are the problems associated with too much water on or near the surface. This excess water may be a chief cause of poor stocking in established pine stands or may explain why certain sites are taken over by less valuable species. Many people have speculated that removal of timber on low, wet sites reduces the transpiration draft and thus allows the water table to rise. A recent study in tidewater Virginia indicates that this is true. A series of ground water wells were installed on a straight line extending from the center of one clear-cut strip into other uncut, clear-cut, and selectively cut strips (fig. 9). This level area was once covered by a heavy stand of pine and hardwood timber growing on Bladen silt loam.

Under the selection stand the water table was at a lower level during the growing season than in the adjacent clear-cut strip. The same effect of a timbered stand was recorded under an uncut strip of timber. At 1/2-chain distance away from either timbered stand the water table was

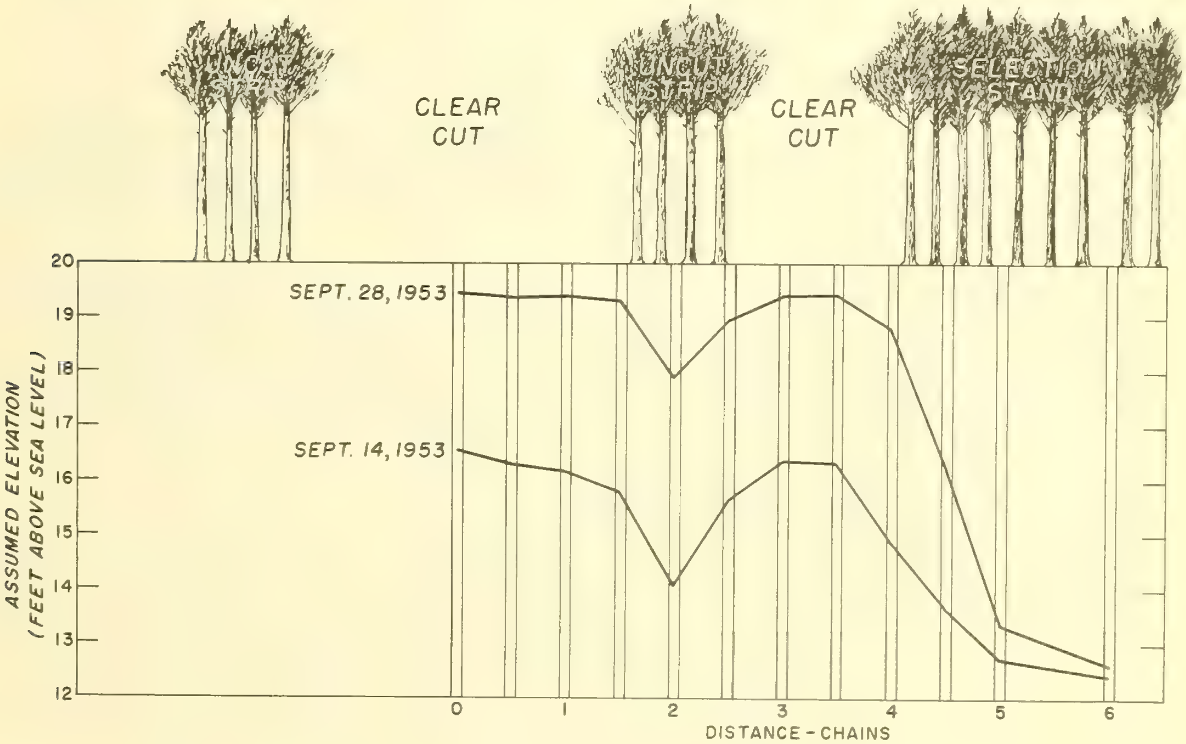


Figure 9.--Typical water-table profiles through different types of stands on the Bigwoods Experimental Forest.

at a uniform high level. During the period September 14 to September 28, 3.21 inches of rain raised the water table about three feet in the clear-cut area and an insignificant amount 2 chains within the selection forest.

FINANCIAL ASPECTS

Mountain Logging Costs

Factors affecting the cost of logging mountain hardwoods were the subject of an intensive investigation made at some 30 different logging operations within a 75-mile radius of Asheville, N. C. The results of this study appeared recently in Station Paper No. 32, "Logging Methods and Costs in the Southern Appalachians," by Robert A. Campbell. Some of the report's highlights are: (1) Log making--power saws will do the job at half the cost of hand sawing. Most efficient use of power saws requires that delay time be kept low and saw performance high. (2) Skidding--medium tractors (D5 and TD9) are consistently the cheapest motive power for all distances and load sizes; teams are second best. Light tractors (D2 and TD6) are not very practical in mountain logging. Regardless of equipment used, capacity loads should be skidded whenever possible. (3) Loading--power loading is more efficient than hand loading only in situations where there are no bank-loading spots or when logs are both skidded and loaded by the same machine. (4) General--Intelligent supervision, proper size of crew, and advance work planning will make logging both easier and safer for the worker and produce substantial savings for the operator. Total logging cost per M board feet is inversely related to tree size; it is nearly twice as high for 12-inch trees as for 24-inch trees.

Board Widths Obtainable From Pine Trees of Different Diameters

Timber buyers and appraisers, particularly those in pine "roofer" areas, might gage the value of a tract of timber more accurately if they had an estimate of the percentages of various board widths which might be produced from a particular stand.

In 1935 Telford and McMillan determined the board widths which could be cut from loblolly and shortleaf pine trees of different diameters. Studies made at 10 separate operations by the Hitchiti Research Center showed that the estimates are still applicable. Board-width yields obtained from representative stands of different average diameters are given in table 4.

Effect of Utilization on Topwood Volume

Many sawtimber stands are cruised and sold on the basis of an 8-inch merchantable top. But often the operator will cut to a 6-inch top or beyond, particularly on the smaller trees. He gets an unpaid-for volume in small, knotty logs, but on the other hand, the seller may be cut out of a possible topwood sale for pulpwood. Inspection of table 5, developed in a cooperative study with the Westvaco Experimental Forest, in South Carolina, shows that in cutting to a 6-inch rather than 8-inch top, the potential pulpwood volume in the smaller trees may be reduced by about 80 percent.

Table 4.--Actual versus estimated board widths obtained in a pine roofer operation in stands of different average tree diameter

(In percent of total)

Average d.b.h. of stand (Inches)	Volume cut	Basis	Board width (1-inch thickness)				
			4 & 5 inches	6 inches	8 inches	10 inches	12 inches
	M bd.ft.						
12.4	233	Actual	26	46	26	2	--
		Estimated	27	45	22	5	1
13.3	49	Actual	25	35	24	16	--
		Estimated	19	37	25	13	6
14.8	68	Actual	15	32	42	11	--
		Estimated	15	33	34	16	2
16.5	27	Actual	18	20	25	21	16
		Estimated	14	22	25	25	14
17.9	7	Actual	11	22	30	13	24
		Estimated	7	20	24	27	22

As a further aid in estimating yield of pulpwood from tops, topwood volume tables prepared from data collected in Dooley County, Ga., have been prepared for slash and longleaf pine. They are published in Station Research Note 42.

Log Grades and Lumber Grade Recovery for Southern Pine

A system of grading southern pine logs has developed from a cooperative project by the Southern and Southeastern Forest Experiment Stations, the Forest Products Laboratory, and the Southern Region of the U. S. Forest Service. This log-grading system--described in the report, "Interim Log Grades for Southern Pine," published by the Southern Forest Experiment Station in 1953--provides a means of estimating the quality of logs in terms of yard lumber grade recovery or dollar value per thousand board-feet. The new grading system is simpler than those used earlier and stratifies the logs into value groups more accurately. A series of lumber-grade yield studies for the various species and timber types of southern pine will do much to increase the value and use of these log grades.

Grade yields have been analyzed for the logs which were used in developing the new log-grading system. The percentage of lumber-grade yield by log grade at each of two locations is shown in table 6.

Table 5.--Topwood volumes per M board feet of sawtimber[1] (Int'l. 1/4-inch rule)

D.i.b. utilization		D.b.h. class					
Sawtimber	Topwood	10	12	14	16	18	20
Inches	Inches	Cubic feet					
6	4	37	14	7	--	--	--
6	5	28	10	4	--	--	--
8	4	207	64	30	--	--	--
8	5	189	57	24	12	7	5
8	6	--	--	--	9	5	4
10	5	--	--	--	40	21	13
10	6	--	--	--	35	18	11

1/ Basis--310 loblolly pines in the South Carolina Coastal Plain.

Table 6.--Average yard lumber grade recovery by log grade in the loblolly-shortleaf pine type

(In percent of rough green lumber tally)

Lumber grade	South Carolina Coastal Plain				Georgia Piedmont			
	Log grade				Log grade			
	1	2	3	4	1	2	3	4
B & btr	51	31	13	1	-	50	17	4
C	24	21	10	3	-	18	12	4
# 1C	23	34	29	8	-	26	35	25
# 2C	2	14	47	80	-	5	34	64
# 3C	(1/)	(1/)	1	8	-	1	2	3

1/ Negligible.

Log value can be estimated from the foregoing table. An easier method is by means of log quality indices which express grade and board-width recovery in a single number. This number is so derived that it states the unit value of all the lumber in a log when the unit value of No. 2 common 1 x 8 boards is taken as 100. Table 7 illustrates the use of the indices in arriving at log values. It also illustrates the very wide spread in value per M board feet of the lumber in high-grade logs ($171) compared with low-grade logs ($75).

Table 7.--Average lumber value by log grade for loblolly and shortleaf pine, South Carolina Coastal Plain Study

Interim log grades	Average log diameter	Average log quality	Price of #2C lumber	Lumber value per M b.f. of logs (Price #2C x quality index / 100)
	Inches	Index	Dollars	Dollars
1	18.8	244	70.00	170.80
2	14.7	190	70.00	133.00
3	13.2	146	70.00	102.20
4	11.1	107	70.00	74.90

SUSTAINED-YIELD PILOT PLANT

A 2200-acre pilot plant on the George Walton Experimental Forest near Cordele, Ga., is in its fourth year of operation. During the interval, this large-scale test of sustained-yield management in the longleaf-slash pine type has shown a gross annual stumpage return of $5.94 per acre. Two years before cutting began, an inventory showed only 1130 board feet per gross acre, part of which had been worked out for naval stores. Cuts as low as 500 board feet per acre have proven commercially feasible. In this typically understocked forest, strict area regulation will be impossible for some time. The worked-out older timber must be liquidated, leaving a preponderance of young age classes. At present, this irregular forest seems best suited for even-aged management by groups and stands.

As part of the development program on the pilot plant it was found that wide annually burned fire lanes provide the best protection in this area where people burn at will. This type of protection costs 79¢ per acre annually. However, it has resulted in practically 100-percent restocking of previously fire-swept slash pine sites. A growth rate of 500 to 750 board feet should result as the growing stock builds up.

FARM WOODLAND MANAGEMENT

Farm Woodlot in Tenth Year at Olustee

Most of the Station's research centers have had one or more experimental farm woodland tracts in operation for several years. The one on the Olustee Experimental Forest is in its tenth year of operation. Sawlogs, pulpwood, crossties, fuelwood, and posts were cut and sold annually at the stump. Gum was sold at the roadside. Over the 9 years 1944-1952, the average net return to the farmer was about $350 on 37 acres, or an average of $1.82 per acre for stumpage plus $0.77 per hour of labor for working up the products. The hourly figure has costs of tools and equipment deducted, but no deduction has been made for taxes, insurance, and other incidental costs.

The condition of this farm woodland has improved from year to year. For the first few years the volume cut exceeded the volume growth in order to clear the area of worked-out naval stores trees, which originally made up 25 percent of the merchantable volume. Since then, the growth has exceeded the cut (fig. 10). Basal area has increased about 10 square feet per acre, number of trees per acre has increased about 50 percent, and present growth is at least 30 percent more than it was in 1944-45. The yield of gum has increased from an initial 156 barrels per crop to 225 barrels per crop, reflecting the faster growth and increased vigor of the trees.

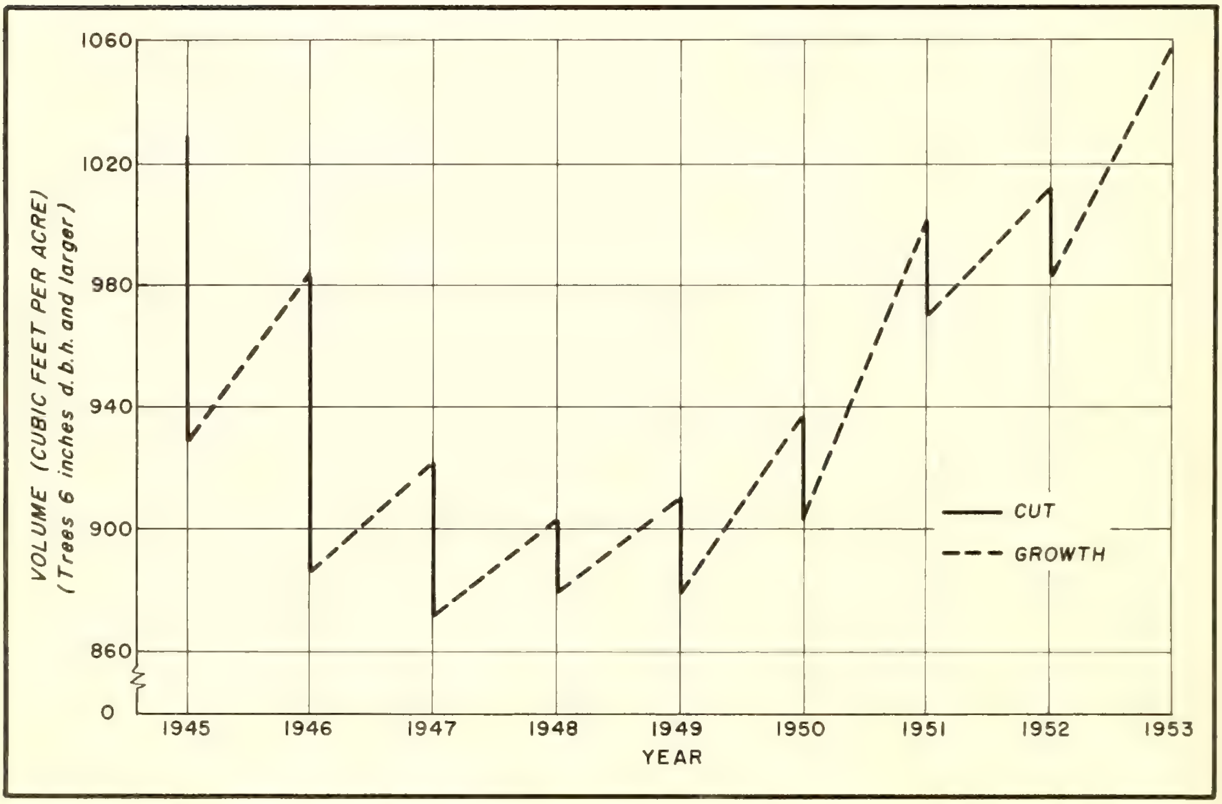


Figure 10.--Trend of growth and harvests on the 37-acre Olustee Farm Woodland. Heavier cuts were made at first to remove worked-out trees and other poor growing stock.

LARGE-SCALE TESTS OF MANAGEMENT SYSTEMS

Included in the program at five research centers are comprehensive term tests of management systems. Altogether there are 166 areas or compartments ranging from 30 to 100 acres in size. Their primary objective is to give timberland owners and managers adequate information as to desirable systems of handling timber in keeping with basic management objectives. As a sample, the set of treatments that are being compared in one large-scale test of management systems of loblolly pine is shown in table 8.

Table 8.--Design of large-scale test of management systems for loblolly pine on the Bigwoods Experimental Forest in North Carolina

Minor treatment	Even-aged management				All-aged management		
	Major treatment				Minor treatment	Major treatment	
	Short rotation[1]		Long rotation[2]			Residual volume[5]	
	Seed tree[3]	Strip[4]	Seed tree[3]	Strip[4]		High	Low
	Number of compartments					No. compts.	
Extensive stand improvement					Stand improvement		
					High level	2	2
With fire	3	1	1	1	Low level	3	3
Without fire	3	1	1	1	None	1	1
Intensive stand improvement							
With fire	3	1	1	1			
Without fire	3	1	1	1			

[1] 30-40 years. [2] 60-70 years. [3] 8-10 seed trees per acre. [4] Leave strip 1-chain wide; cut strip 3-chains wide. Final cut 3-4 years after initial cut. [5] 5-year cutting cycle.

Obviously, the ultimate results from these studies will not be available for a number of years. In the meantime, they serve as excellent demonstrations of various management systems, and produce many worth-while interim results. For example, much of this Station's recent information on the reproductive habits of loblolly pine has been gained from this large-scale test of harvest cutting methods at the Bigwoods Experimental Forest. Furthermore, all the logs used in the development of the Interim Southern Pine Log Grades came from cuts on the Hitchiti and Santee Experimental Forests. In addition, the compartments are convenient as pilot plants for results obtained from sample plots or other limited tests. Much of the large-scale testing of prescribed burning, poisoning, and other cultured measures has been done on these compartments.

Of somewhat academic significance are the interim financial returns realized from the sale of stumpage and products obtained from the compartments as a consequence of prescribed treatments. An example may be taken from the records at the Santee Experimental Forest located in the South Carolina Coastal Plain. Initial formative cuts on 1109 acres of loblolly pine divided into 28 compartments have yielded an annual gross return of $9.80 per acre for stumpage. This is impressive considering that most of the early treatment was designed to make the area even more productive in later years.

NAVAL STORES

Development of Acid Stimulation

Some small exploratory studies in the effect of strong acids on gum flow were begun in 1936. This work was not pushed, as labor was plentiful in the gum naval stores industry. But World War II disclosed a real need for a labor saving method of turpentining. As the various aspects of acid treatment became apparent, more and more efforts were concentrated on the problem. By 1946 some commerical benefits began to appear, largely by way of pilot plant operations. By 1950, a good practical technique had been developed that any woods laborer could understand. Also, substantial benefits had become apparent to the whole gum naval stores industry. Since then, research has been concentrated on various refinements to the basic technique.

An estimate of the relation between the cost of development and the resulting benefit to gum producers is illustrated in figure 11. As shown, all the expenses of a decade and a half of research were repaid during the first 5 years of commercial use. And the benefit to industry this year is about 20 times the current allotment for research.

Fundamental Studies

Turpentining reduces the growth of trees, but the profit on gum is many times greater than the loss resulting from reduced wood increment. During the past year, quantitative data were obtained for the first time on the loss in wood increment resulting from the use of bark chipping and sulfuric acid treatment on young slash pines in plantations. On 20-year-old trees 10 to 11 inches d.b.h., current annual increment on worked trees was about 73 percent of that on round trees during the first season of turpentining. The increment was nearly the same for both the bark-chipping, acid-treating method and the wood-chipping method.

Tests of new chemicals as possible replacements for sulfuric acid in treating naval stores streaks have been continued, but none has yet been found practical.

New Methods in Testing Stage

Preliminary tests indicate that the labor costs in gum production might be reduced by more intensive methods of working trees over shorter periods of time. Experiments are under way to determine whether the labor requirements can be reduced by using higher streaks and higher concentrations of sulfuric acid with fewer streaks per year or with fewer years of work per face.

Proven Methods

Tests of different streak heights and experience of commercial gum producers have demonstrated that for most operations 3/4-inch is about the optimum streak height for use with bark chipping and treatment with 50 percent sulfuric acid at biweekly intervals on both slash and longleaf pine (fig. 12). This technique will permit 4 years of work on a face without reaching the "pulling stage."

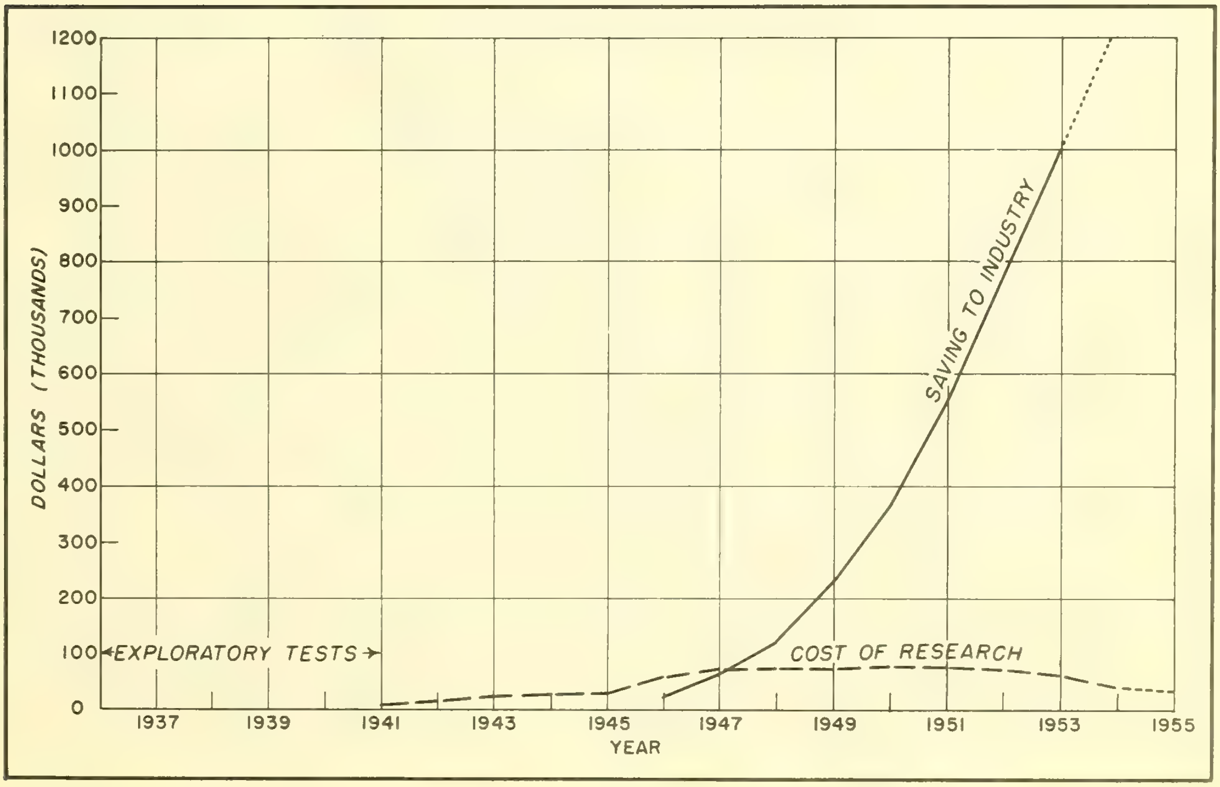


Figure 11.--Relation between cost of research and benefit to gum naval stores industry from development of bark chipping and acid treatment. Potential benefit estimated at 2-million dollars or more annually to be reached in 1960.

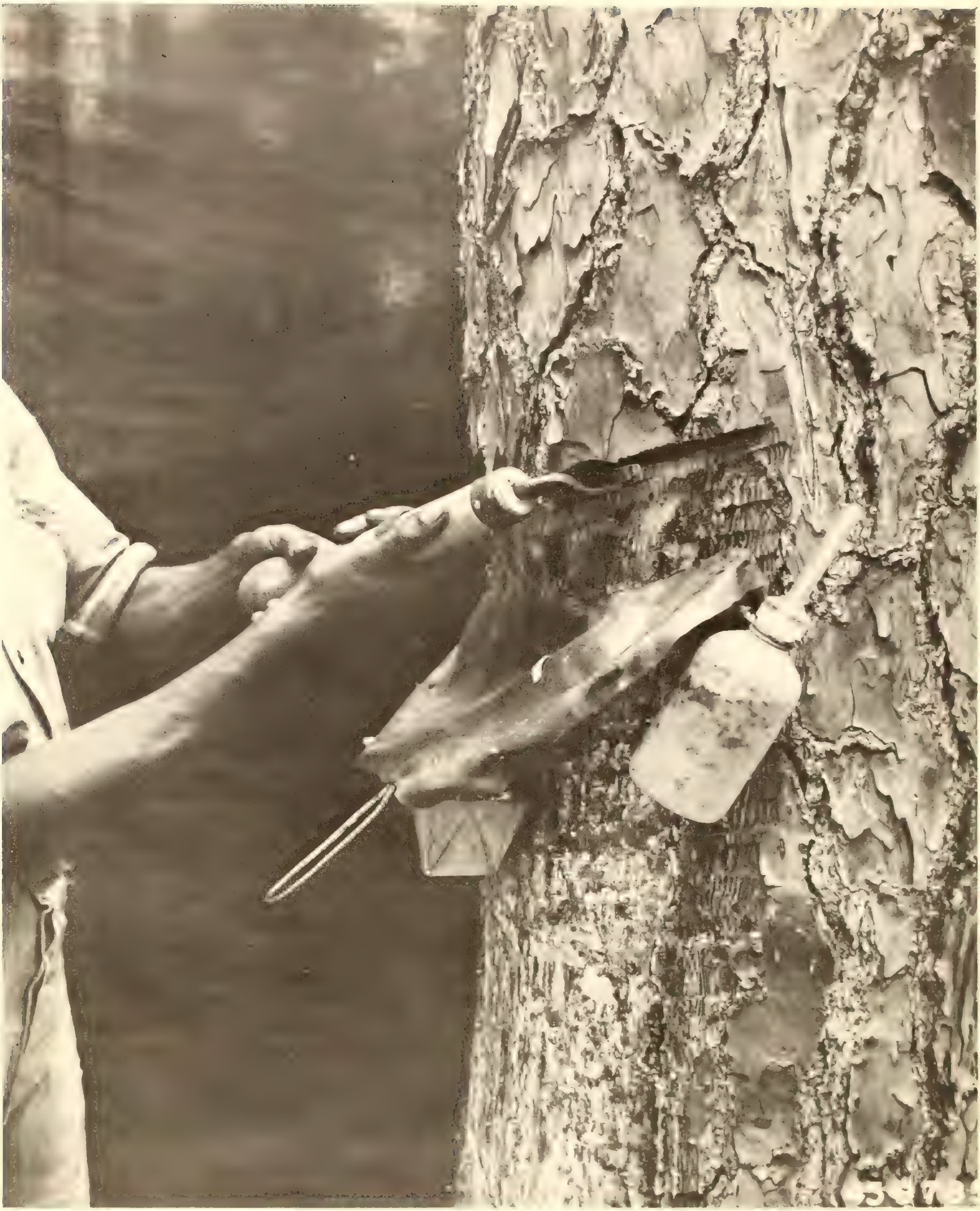


Figure 12.--A gum farmer using the bark chipping and acid treatment method of turpenting. The bark hack, spray bottle, 2-quart cup and spiral gutter (covered by cup apron) were all developed by research at the Station.

A major advance in gutter installations is the use of spiral gutters attached to the trees with double-headed nails. Advantages are:

1. Increase in gum yields of about 20 percent more than those obtained by use of gutters inserted into broad-axe cuts.
2. The same gutters and nails can be used for the virgin installation and for the successive raised positions on a face and thus reduce the cost of materials.
3. The gutters can be easily and economically removed after turpentining is completed. This makes possible the sale of the tree at full stumpage value without a deduction for a jump butt. For landowners who work their trees with modern turpentining techniques, this means an advantage of more than $4,000 on every crop of 10,000 naval stores trees sold for sawlogs.

Equipment Development

The elevation of gutters and cups on a turpentine face has always been a troublesome and expensive chore on commercial naval stores operations. To make this job easier and more economical, a new combination tool has been developed which permits one man to do the entire job of removing nails and gutters and installing them at the higher level. Because of the limitations of existing tools, this job is usually a two-man operation.

The new tool has a specially designed claw on one end to remove double-headed nails without bending either nails or gutters. On the other end is a claw for removing cup nails. Opposite this claw, a hammer head is attached to the tool for driving both cup nails and double-headed nails. Hence, one man can do both the removal job and the re-installation.

After the tool is thoroughly tested, a search for a manufacturer will be made. The tool probably will be available commercially by the end of 1954.

FOREST ECONOMICS

Timber Inventory of Georgia Completed

On October 30, 1953, the timber inventory of Georgia was finished. During the year field work was completed in fifty-one counties located in the northern Piedmont and mountain areas. Field crews measured the timber on 1,870 sample plots, and the area of forest land surveyed amounted to 6.4 million acres. Cooperation was received from the Union Bag and Paper Corporation, the Georgia Forestry Commission, and the University of Georgia School of Forestry.

Large Increase in Forest Area of Georgia

The resurvey of Georgia revealed a 12-percent increase in forest land area since the original Forest Survey of 1934-36. This increase amounted to 2,624,100 acres, making the present forest area of the State 24,056,600 acres. Reversion to forest was greatest on the idle and abandoned farm lands of the Piedmont, but there were also increases in the Coastal Plain and mountain areas. One important use for this new forest area estimate will be to provide the Georgia Forestry Commission with a reliable and up-to-date base for computing costs of fire protection.

Area	Forest land increase
	(Acres)
Coastal Plain	270,800
Piedmont	2,086,100
Mountains	267,200
State	2,624,100

Timber Supply Declines in Central Georgia

Portable sawmills have long been active in the lower Piedmont of Georgia. In recent years this area also has provided large quantities of pine pulpwood for local pulpmills. The trend in timber supply is of direct concern to these industries, as some have large investments in permanent plants. Results of the latest timber inventory show cause for concern. In the period between the original survey of 1936 and the resurvey of 1952, sawtimber volume decreased 31 percent and the volume of all growing stock 5.0 inches d.b.h. and larger decreased 14 percent. Comparable decreases for pine were 38 and 20 percent. There is evidence that the supply of hardwood timber is beginning to increase, as growth exceeded drain in 1952. Pine timber was still being overcut. Inventory data show clearly, however, that there is a marked increase in the number of young pines. If the downward trend in the supply of pine timber is to be reversed, public and private forestry programs must provide for improved protection and management of these young stands.

New Forest Statistics for Southeastern North Carolina

The resurvey of Southeastern North Carolina (Survey Unit 1) completed in 1953 provides up-to-date information on the timber supply situation. Since 1937, when the original survey was made, there has been a slight decrease in forest area. Pine forests now occupy nearly three-fourths of a million fewer acres than in 1937. There is better stocking of young timber, both pine and hardwoods, but pine trees 12 inches in diameter and larger have decreased in number. Only 5 percent of the commercial forest land is well stocked with sawtimber. Since 1937 the volume of hardwood sawtimber increased 10 percent, whereas pine sawtimber decreased 10 percent. During the period between surveys the volume of timber cut has apparently been greater than at present, for the current relationship of growth and drain leaves a margin which is building up the growing stock. Whether or not this will continue will depend upon the future demand for wood products and the effectiveness of forest management practices aimed at increasing the supply of timber.

Unused Slabs and Edgings at Small Sawmills

Recently there has been considerable interest in the possibilities of pulping sawmill slabs and edgings. As a result, log barkers and chippers have been installed at a number of lumber plants. However, the great bulk of slabs and edgings is produced at sawmills too small to justify the installation of such equipment. The fact that there are thousands of little mills and that many are portables is a further complication. Current investigations in a typical area of the pine roofer belt in South Carolina are designed to shed light on salvage problems at small sawmills.

One of the first subjects investigated was the already existing uses for slabs and edgings. Before gasoline and diesel power units were introduced in the Thirties, a considerable quantity was burned to generate steam for sawmills. Now, the only use is home fuel. With the extension of electricity to rural areas and increased use of oil and bottled gas for heating and cooking, even this demand has declined greatly. In the study area, only 27 percent of the available volume is actually sold for this purpose. The price of uncut slabs at the mill site was found to average only $1 a cord, and the highest price noted was only $3. Fifty-four percent of the sawmill residues are left to rot on the ground. How the sawmill operators and landowners disposed of the slabs and edgings is shown below:

	Percent
By the sawmill operators:	
Sold as fuel	8.4
Used as home fuel	2.4
Given away	2.6
By the landowners:	
Sold as fuel	18.8
Used as home fuel	11.5
Given away	2.4
Unused	53.9
Total	100.0

Pulpwood Prices and the Value of the Annual Cut

Rough pine pulpwood, which sold for $13.75 per cord f.o.b. railroad car in most sections of the Southeast during 1953, averaged only $7.15 per cord 10 years ago in 1943 and only $3.55 15 years ago. These values are from a price series covering the period 1938 to 1952 inclusive. The series was prepared from reports furnished by seven representative pulpmills that purchase about half the pulpwood currently produced in the region.

In 1952 the average price of all the pine pulpwood purchased (including railwood, truckwood, and bargewood) was $13.90 per cord. Pine pulpwood production for the year in Virginia, the Carolinas, Georgia, and Florida amounted to 7 million cords. Therefore, it was worth $97,300,000. If prices elsewhere in the South were similar, the total harvest of pine had a value of $177,400,000. Including hardwoods, the South produced about $200,000,000 worth of pulpwood.

A Method of Calculating the Effect of Log Size on the Cost of Sawing Pine Lumber

It has been estimated that 15 to 25 percent of the lumber sawed at small sawmills is produced from marginal or submarginal logs--logs that yield no profit to the lumberman and frequently little or no return to the landowner. Operators who sell their lumber on a green, mill-run basis are most likely to fall into this uneconomic practice. This happens because they receive the same price for all grades and sizes of lumber. What they overlook is that their output and sawing costs are related to log size even though the value of their lumber is not.

The results of a time study in the South Carolina Piedmont offer operators of mill-run pine sawmills a method of calculating their sawing cost per thousand board feet for logs of any size. By comparing the calculated costs with the price of lumber, each operator can determine the marginal size of log for his mill and crew. He can also compare logs of various diameters and lengths as to the profit or loss involved in sawing them. Results of the study will be published in 1954.

WATERSHED MANAGEMENT

Integration of Water and Timber Management

Recent droughts have raised anew the question whether summer streamflow can be increased through watershed management. To find the answer, the Southeastern Statuon is studying changes in streamflow brought about by cutting vegetation, defoliation during the summer months, and by changing the composition of the forest stand. A special review of experimental results was carried out during 1953 to summarize what has been found out on experimental watersheds at the Coweeta Hydrologic Laboratory.

Results to date show that cutting of old-growth hardwood stands definitely increases total water yields as summer streamflow under the high rainfall conditions of the Southern Appalachian Mountains. In the application of this fact, however, it is the amount and duration of favorable effects that become of practical interest.

In experiments conducted at the Coweeta Hydrologic Laboratory the largest sustained increase in water yield was measured where all tree and other woody vegetation was cut, and where subsequent sprouts were cut back each year in midsummer. In this case, streamflow was increased the first year by an amount equal to a volume of water 17 inches deep over the entire watershed. Since the original cut, the major woody sprouts have been cut back, but there are now herbaceous plant species, low briars, and vines invading the watershed. This invasion has changed the increase in streamflow from the original 17 area-inches for the first year after cutting to only 9 inches increase 12 years later. This was primarily an orientation study to establish the maximum effects on water yield that can be obtained through cutting an old-growth hardwood forest. For applied watershed management it would not be necessary or practical to aim at such large increases. Increases of only a few inches during the late summer and fall would be of tremendous value during drought years.

On another similar watershed all woody vegetation was also cut to begin with, but then the forest was allowed to grow back naturally. The first year after cutting, streamflow increases were comparable to those mentioned above, but this favorable yield diminished rapidly for the first 3 years, after which the decline was more gradual. The annual increase in yield for the 3-year-old coppice forest was 10.7 inches; after 7 years regrowth 8.1 inches; and at 12 years 4.9 inches.

On still another watershed where only the laurel and rhododendron understory was cut from an old-growth hardwood stand, the average increase in water yield for the first 2 years was 3.6 inches. The third year it was 2.4 inches and for the 4th year only 1 inch. During the 5th year any increase over the precutting period was insignificant, probably not because of regrowth of the understory, which was slow, but rather because of expansion of the roots of trees to use the available water.

Cutting a strip along the water course also produced significant gains in streamflow during the summer months only. On one 20-acre watershed where a narrow strip was cut along the stream (fig. 13), increases in

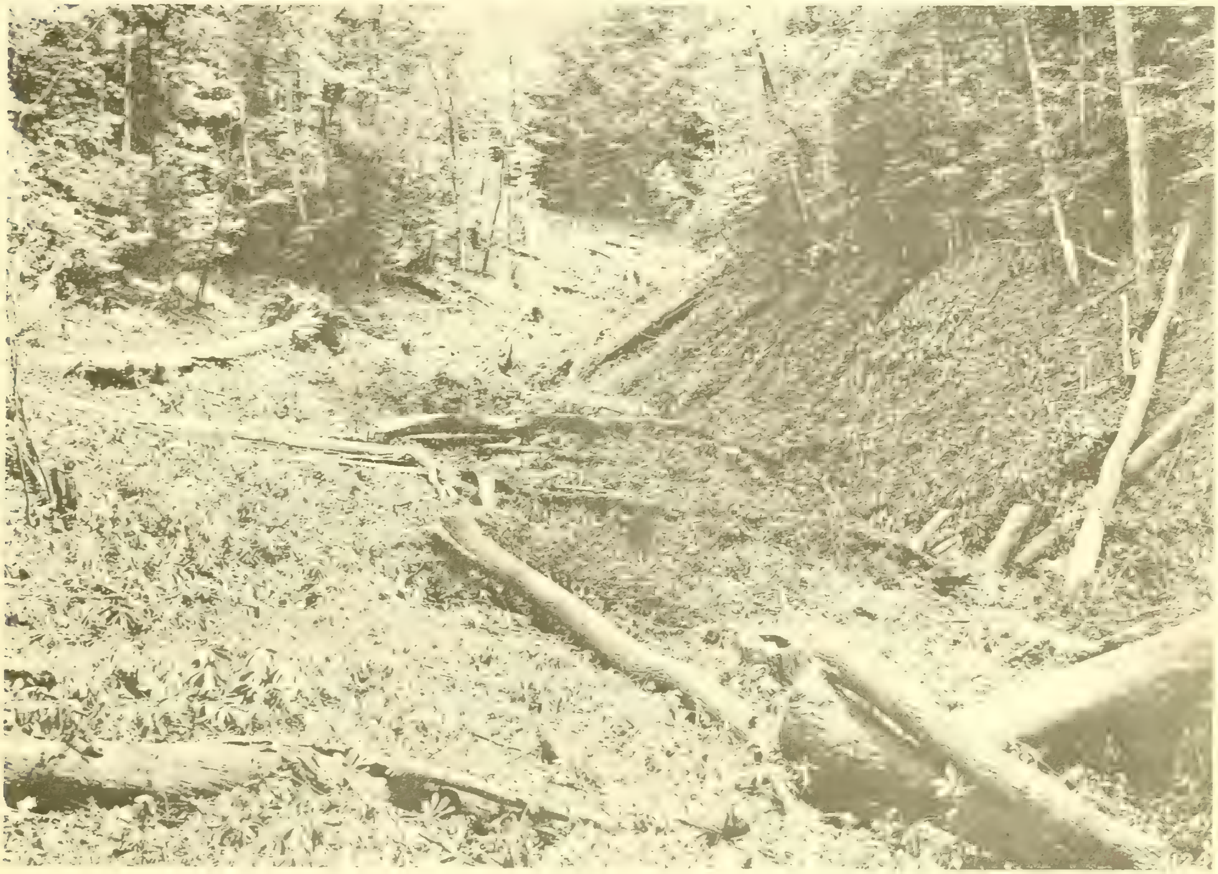


Figure 13.--An experimental watershed from which streambank vegetation was cut to see whether flow would be increased and if so how much and how long.

water yield were 365 to 475 cubic feet per day during the growing season of the first year. For the same period in the second year following cutting, average daily gains were from 135 to 300 cubic feet. By the third year sprout vegetation had become well established and no further increases were detected.

The above four experiments give some idea of the magnitude and duration of increases in streamflow obtained by cutting forest vegetation in the high rainfall area of the Southern Appalachian Mountains. It does not follow that the similar results would be obtained under different soil and climatic conditions. These results serve only as a guide to streamflow increases obtained through cutting in mountain hardwoods.

For small industrial or municipal watersheds where current requirements exceed the streamflow by relatively small margins and for short periods of time during the summer months, watershed management involving control of vegetation by cutting merits careful consideration as a feasible alternative to expensive reservoir installations. Where no suitable reservoir sites are available, watershed management practices are the only procedures available. As already mentioned, even a small increase in streamflow can be quite important. For example, one area-inch increase of water from one square mile is equivalent to 18,424,000 gallons. This would supply a population of 5000 for more than 36 days with 100 gallons per capita per day.

The cutting of forest vegetation specifically to increase water yields may be costly. Other means of reducing the vegetation such as the use of silvicides, gas, and sprays are being tried. Doubtless the most feasible approach is to reduce the stand density by harvesting wood products in such a way that water yields are increased at times when shortages are most likely to occur.

For the present, the important step is to include a consideration of water resources in all forest management plans. The logical step is to integrate what has been learned about the general effects of cutting on streamflow with practical silvicultural systems for managing specific forest stands. Also, the time of year when harvest cuttings are made is an important consideration, so that periodic cuttings will be most beneficial to summer streamflow.

Although cutting increases streamflow, experiments so far indicate that the soil profile under a forest cover is particularly effective in the control of storm water and the storage of ground water. The conclusion is that a managed forest constitues the most favorable type of watershed cover, providing cutting practices are aimed at maintaining a suitable stand density

The Station is now preparing a report of 20 years' results of watershed management experiments on the Coweeta Hydrologic Laboratory, to be completed in 1954.

Future Watershed Experiments Recommended

During 1953 a special program conference was held for the purpose of discussing plans for future watershed experiments. The conference was attended by representatives of both the Administrative and Research branches of the Forest Service. The general recommendations included the following points:

(1) Present studies should be expanded to include further tests of methods for managing commercial timber stands to insure favorable water yields and at the same time provide reasonable returns from forest products.

(2) Additional studies are required to compare the relative effectiveness of well maintained grass sod with forest cover for watershed protection. Similarly, a comparison is needed of hardwood forest and a pure stand of conifers.

(3) On experimental watersheds that now exhibit serious deterioration of water resources due to unfavorable land-use practices, the rate of recovery of soil and water resources brought about by recommended improved practices should be observed.

Information and Education Activities

A large portion of staff time during the year was taken up by visitors at the Coweeta Hydrologic Laboratory. Seventy-five tours of the area were arranged for 864 visitors. One hundred foreign technicians came from 20 different countries, some spending from 1 to 2 weeks. There are also six university graduate students affiliated with the Coweeta Laboratory in the preparation of thesis material. In addition, the staff was called upon to conduct three training sessions of several days each for in-service personnel. Talks before technical organizations and civic clubs required considerable overtime, and operation of the basic research program was curtailed by these demands on the time of the technical staff.

Improvement of Piedmont Forest Soils

At the Calhoun Experimental Forest in South Carolina, an entirely different approach is being made to watershed management. Here the problem is one of rehabilitation of the degraded and abandoned cotton lands of the southeastern Piedmont. Studies are under way on present soil problems and to develop management programs for soil improvement. These studies are directed toward finding out how to increase infiltration and storage of water in the soil by improving the soil structure. During 1953, results have been obtained on the comparative effects of litter from different plant species on a basis of rate of decomposition and incorporation of these organic materials and plant nutrients into the soil profile.

Pure pine litter was resistant to decay and only slightly attacked by insects. Pine litter tends to accumulate at the surface because the type of biological activity under pure pine does not result in incorporation of the litter into the mineral soil. On the other hand, litter from hickory and yellow-poplar is subject to rapid decomposition and incorporation as organic matter into the mineral soil.

In mixed pine-hardwood stands where the hardwood species consist of redbud, dogwood, maple, yellow-poplar, and hickory, the litter decomposes rapidly and is easily incorporated into the mineral soil.

The relative rates and ease of decomposition of the surface organic layers are substantiated by measurements of the organic matter content of the mineral soil. The quantity of organic matter in the surface foot of mineral soil under the pine stands studied averaged 31,770 lbs., under pine-hardwoods 53,353 lbs., and under all hardwoods 65,573 lbs. Since nitrogen in the soil is closely correlated with organic matter content, the same relative relationship holds for nitrogen as for organic matter.

The type of humus layer present is also useful in describing the hydrologic characteristics of forest soil. Soils where organic material has been incorporated have greater porosity, can store more water, and transmit it more rapidly than bare soils where incorporation has not taken place.

The nature of incorporation of organic material into the forest soil has a direct relation to the use of prescribed burning in the Piedmont. It was also found that the nature of the surface organic layers will influence the intensity of the fire. Loose pine needles are more easily consumed than a compact layer of hardwood leaves. Removal of the forest floor by fire is least serious where organic material has been incorporated into the soil because the properties of the mineral soil are such that they can absorb and transmit water even when exposed. Also, less of the nutrient capital is destroyed by fire on sites where much of the litter is currently taken into the mineral soil and does not accumulate at the surface. When fire consumes the litter layers, the elements are either volatilized or left in the ash, in which form they are susceptible to leaching and washing away. If they are lost to the site after a fire, the effect on the fertility will be most pronounced where the reserve of such material in the mineral soil is least.

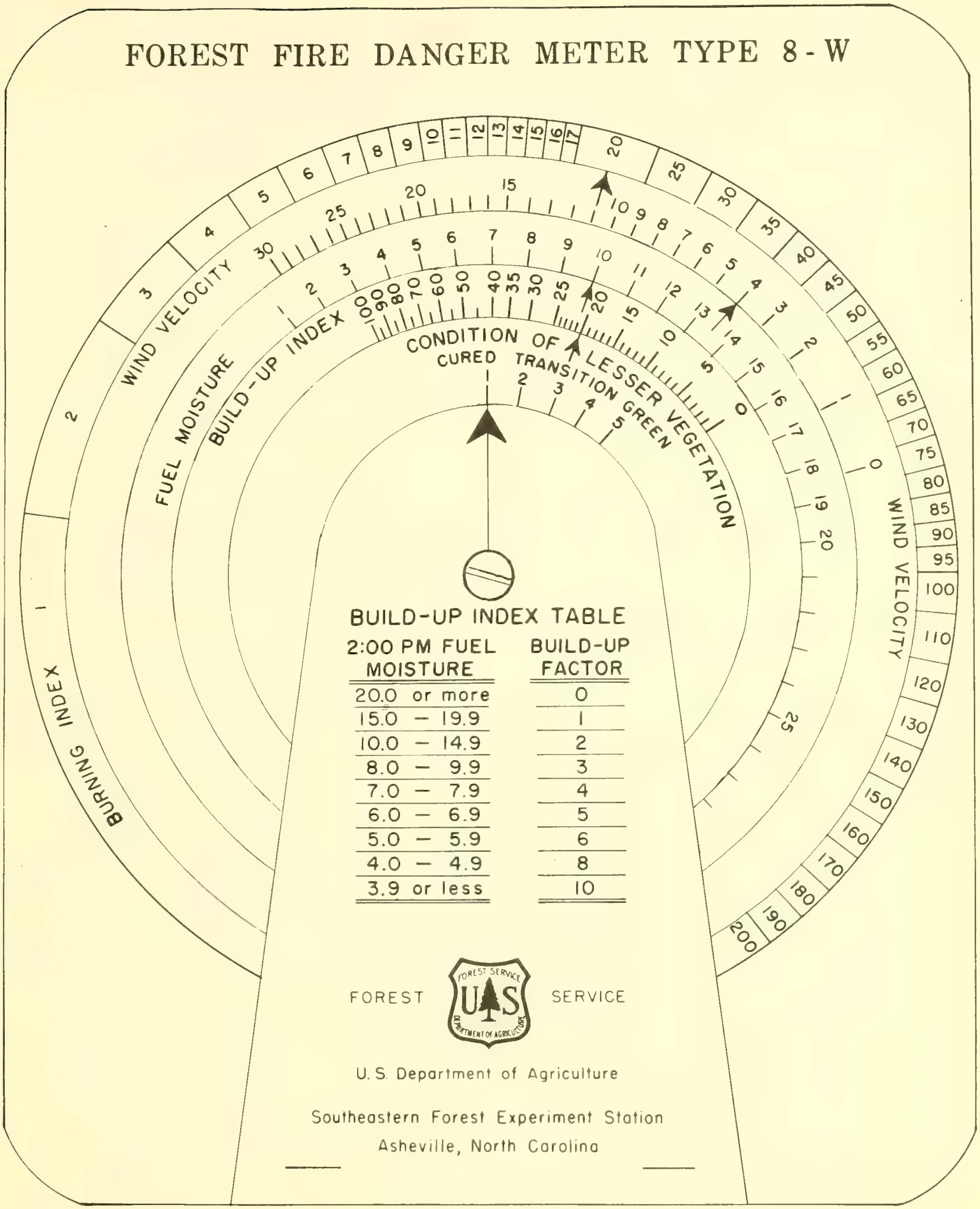
Thus it has been shown that the organic layers of forest soils are a valuable diagnostic tool for timber and watershed management. They can be changed by modifications of the vegetation on the site. Studies to date show that where Piedmont forest soil needs improving, steps should be taken to manage the stands so that some rapidly decomposable hardwood litter will be incorporated. Such conclusions may serve as a brake on the enthusiasm of foresters who advocate pure pine stands on eroded Piedmont farmlands.

FIRE RESEARCH

New Danger Meter Developed

A new fire danger meter, type 8 (fig. 14), developed largely by J. J. Keetch, Region 7 cooperator, has been designed to replace type 5 used by fire control agencies throughout the Northeast. The latter type has served many useful purposes in measuring daily danger in fire prevention, as a guide to woods closure, in comparing seasons and field units, and in organizing for presuppression and control. However, as greater familiarity was gained by field men in these many uses, the need for greater precision in measuring danger became apparent.

Because a large volume of accurate records was available for analysis as a result of long cooperation with the northeastern states, it was possible to devise a meter that retained the basic principles of the type 5 meter but



BUILD-UP INDEX TABLE

2:00 PM FUEL MOISTURE	BUILD-UP FACTOR
20.0 or more	0
15.0 – 19.9	1
10.0 – 14.9	2
8.0 – 9.9	3
7.0 – 7.9	4
6.0 – 6.9	5
5.0 – 5.9	6
4.0 – 4.9	8
3.9 or less	10

U. S. Department of Agriculture

Southeastern Forest Experiment Station
Asheville, North Carolina

Figure 14.--Type 8 danger meters were adopted by all fire control agencies in the northeast January 1, 1954. The new meter gives a better estimate of daily burning index and fire danger build-up.

which had several new features. For example, by replacing the discs showing days since rain and last rain, inches with a disc showing build-up index, greater accuracy is obtained during extended rainless periods. Also, the transition period in condition of lesser vegetation has been expanded into three classes. This makes the change from one condition to another less abrupt and more consistent with actual field conditions.

The build-up index is a notable improvement because it indicates the progressive drying of the lower fuels, which fuel moisture sticks are unable to do. By cumulating daily "build-up factors," an increase or decrease in the severity of conditions during a critical period is readily apparent. To some extent the index is also a measure of resistance to control in that as the 100 point is approached fires become progressively more difficult to hold because of breakovers. Deeper lines must be cut and more caution used lest smouldering material burn under control lines. Mop-up also becomes increasingly more difficult.

"Blow-up" Fires

Good progress was made during 1953 in the study of the exceptional class of fires often described as "blow-up" fires. This descriptive term clearly implies the idea of suddenness and to some extent the idea of unexpectedness, from the standpoint of the potential danger of these erratic fires to suppression crews.

The problem of extreme fire behavior is complicated by a large number of variables such as fuels, stand type, and topography. It is made more complex by the less known atmospheric variables and their interactions. Its nature can be illustrated best by listing what we now know of both the consistent and inconsistent features of fire behavior:

1. Most severe fires and a considerable number of blow-ups occur during the middle of the afternoon on sunny days. On such days the atmosphere is often turbulent and unstable to a height of several thousand feet. However, some of the worst forest conflagrations in the United States have either occurred at night or reached the peak of their intensity at night (usually between sundown and midnight). At this time the lower layers of the atmosphere (up to 500 feet or more) are usually stable.

2. Some of the worst western fires in the past 15 years have been in rough country, which indicates that topography is a dominating factor. On the other hand, there have been conflagrations such as those that occurred many years ago in the Lake States, which burned in nearly flat or rolling country. Some of these conflagrations have been compared to "tornadoes of fire."

3. An intense fire may occasionally spread rapidly across slope or downslope at night in the general direction of the cool downslope winds. Yet this same rapid downslope spread may happen in the middle of the afternoon when surface winds, if any, would be upslope. The Brasstown fire of March 30, 1953 in South Carolina traveled across drainages (upslope and downslope) as though they did not exist.

4. Instability in the atmosphere seems to be closely related to extreme fire behavior; yet on a large proportion of warm, sunny days the atmosphere is unstable. Fires do not always build up to extreme intensity on such days.

5. Many intense fires have been accompanied by high winds; but some of the most dangerous and erratic fires have burned when the wind speed was not especially high.

6. High temperatures and low relative humidity accompany a large proportion of severe fires, but some of the most intense and rapid spreading fires burn when the temperature is low and falling. The fires in the Southeast in the fall of 1952 are examples.

7. Prolonged periods of drought and dry weather show a strong correlation with intense hot fires, but the Brasstown fire burned only a week after nearly two inches of rain had fallen on ground well charged with winter rainfall.

8. The amount of fuel available to a fire is an important factor in its behavior. At times the effect on fire intensity of an increase in quantity of fuel appears to be considerably greater than would be expected from the actual fuel increase itself.

9. Arrangement as well as quantity of fuel is important. Extreme fire behavior seems most likely to occur in dense conifer stands. Intense fires also build up in stands of evergreen brush, and can readily cross swamps if the brush is dense enough.

10. On those fires most likely to be designated as blow-ups (owing to the sudden and often unexpected build-up of turbulent energy), there is an obvious and well developed convection column which may extend high in the atmosphere.

11. Large fires exhibiting extreme behavior have been known to put up convection columns to a height of 25,000 feet or more. Since 70 percent of the total mass of air is below the tops of such convection columns, these fires have literally "pierced the atmosphere." They are volume phenomena and have storm characteristics like certain other disturbances in the atmosphere. This in part seems to explain why they do not conform to the "rules" of fire behavior. These "rules" are based on the far more frequent ordinary fire, which is pretty much a surface phenomenon.

The preceding statements illustrate the baffling nature of the exceptional fire that does not conform to the accepted principles of fire behavior. They also show the magnitude of the requirements that an effective solution of the problem must meet. However, the problem may not be as difficult as it appears. Our work thus far indicates that those factors which determine the rate at which a fire produces kinetic or turbulent energy may be the elements needed for an overall solution. These factors are stability conditions in the atmosphere, wind speed, wind shear, and available fuel for the fire.

The thermodynamic method, mentioned in last year's annual report, still appears to be one of the most effective tools in the study of the exceptional fire.

FOREST UTILIZATION SERVICE

Cooperative effort was the guiding motive of the Forest Utilization Service in 1953. Cooperation with the states, with other government agencies, with industry, and with individuals keynoted practically every accomplishment during the past year.

An outstanding example was the launching of the Hickory Task Force at Clemson, South Carolina, in April. About 55 representatives of government, states, universities, and industry met to organize eight subject-matter committees and to lay the groundwork for a 3-year program involving research and report preparation. An August meeting of the Executive Committee crystallized the plans and started work. Already, more hickory is being used although the first report has not been published.

Cooperation with the North Carolina Department of Conservation and Development started with a compilation of information to attract new wood-using industries and continued with a cooperatively financed study to ascertain the quantity, quality, and location of the various types of wood residue from primary wood-using industries in North Carolina. This study will be completed and published by the State in 1954.

The increasing scarcity of high-quality timber favors the development and use of log and tree grades. In 1953 the Forest Utilization Service conducted courses in pine and hardwood log grading for the Florida Forest Service and the Appalachian Lumbermens Club. In cooperation with the latter, field studies demonstrated the Forest Products Laboratory hardwood log grades, utilizing a log grading stick developed by Englerth and Ostrander. Also, analyses were made of data collected by a lumber company in applying the southern pine log grades.

Working with North Carolina, South Carolina, and Georgia State forestry personnel, the Utilization Service conducted eight short courses in sawmilling. These were supplemented by numerous on-the-ground visits to small sawmills to assist in milling and seasoning problems.

In cooperation with the School of Forestry at North Carolina State College, an 8-day dry-kiln course was conducted, with Forest Products Laboratory assistance. Also, a 2-day review of the dry-kiln course was given to members of the Southeastern Dry Kiln Club, at Raleigh, North Carolina. The Forest Utilization Service and Tennessee Valley Authority also helped small industries in the mountains in developing plans for dry kilns.

The Forest Utilization Service personnel helped in the work of the Wood Preservation Coordinating Council, an organization of southern schools interested in wood preservation research. This organization was started in 1946 by the Tennessee Valley Authority and has taken a leading role in preservative research in the Southeast. In addition, the Forest Utilization Service conducted a short course in wood preservation for South Carolina forestry personnel.

With the assitance of the Forest Products Laboratory, the Southern Weighing and Inspection Bureau, and the Southern Furniture Manufacturers Association, a survey of furniture packaging methods was made at 20 plants in Virginia and North Carolina.

The Southwestern Forest Experiment Station and a Virginia company making cedar chests cooperated with us in preparing a report on the slicing of Utah and alligator juniper veneer, which may lead to new industrial possibilities in the Southwest.

Six new automatic wood-burning furnaces for tobacco barns were constructed on farms in North and South Carolina, and although two burned down because of improper construction, the others performed satisfactorily. Assitance to the owners of these installations resulted in improved techniques in construction and operation of the furnaces. A blower was installed on a sawdust burner used for curing tobacco, and it functioned exceedingly well for severl cures.

A conference on the use of wood waste as a soil conditioner was arranged and was attended by Forest Service and other government personnel in Washington. Arrangements were made to discuss this problem with Soil Research Committees over the entire country, to encourage needed research at State Agricultural Experiment Stations.

In cooperating with the over-all program of the Experiment Station, the Forest Utilization Service assisted the Timber Resource Review in a survey of wood residue in the woods and at sawmills over the entire Southeast. Work was done with the Tidewater Research Center on an analysis of wood utilization problems in that area. The Forest Utilization Service assisted in a general inspection of the Lake City Research Center. Personal attention was given to 16 foreign visitors interested in southeastern wood utilization problems; these and other visitors were conducted through the territory for specific studies, informational trips, or inspections. Program contributions were made at Forest Products Research Society meetings, county agent meetings, and others. More than 200 inquiries for information were handled by letter, telephone, and personal contact. And new problems were uncovered which led to more research, in accordance with the liaison functions of the Forest Utilization Service.

FOREST RANGE

Determining the value of forest forage and how grazing can be efficiently integrated with timber production are the main objectives of the Station's range research.

Research has shown that grazing in the southern mountain forests damages both land and trees, and seldom pays. To a certain degree the same holds true for forest grazing in the highly erodable Piedmont. But on the wide belt of Coastal Plain pine land extending from Virginia through the Carolinas, lower Georgia, Florida and Alabama, conditions are quite different. Here, forest lands are relatively level and sandy or swampy. Forage production is greater and the valuable pines are not palatable to cattle, which have ranged these forests since the time of the Spaniards. Today, cattle numbers in the Southeast are increasing faster than in any other region of the United States. The average Coastal Plain forest owner is concerned primarily with growing timber, but he is also interested in the possibilities of added income and fire protection from grazing--particularly when the forest stands are understocked, as many of them are.

For these reasons, the Station's forest grazing research is confined to the Coastal Plain. Studies have been restricted to pine types where abundant herbage and minimum erosion offer the greatest possibilities for successful integration of cattle raising and timber production. Within the pine types, research has been concentrated on the two outstanding forage types of the region, switch cane and wiregrass. Cane is the most productive and nutritious type; wiregrass is the most extensive.

Studies in the cane type are being conducted in the territory of the Tidewater Research Center in eastern North Carolina. Work Centers are at the Frying Pan Experimental Forest Range in Tyrrell County, and at the North Carolina Tidewater Test Farm in Washington County. Wiregrass research is centered at the Cordele-Tifton Research Center in south Georgia, with principal grazing studies at the Alapaha Experimental Range in Berrien County.

All of the Station's range research has been conducted cooperatively with other federal bureaus (BAI and BPISAE) and with state agencies. North Carolina State College and Agricultural Experiment Station, and North Carolina Department of Agriculture have cooperated in studies involving the cane type. Georgia Coastal Plain Experiment Station cooperates in studies of wiregrass range in south Georgia.

Additional range research was started this year in southern Florida as a result of special appropriations by the Florida legislature, and contributions from the Collier Company and the Atlantic Land and Improvement Company. Past use of forest land in southern Florida has emphasized grazing at the expense of timber production. As a result, many forest stands have been eliminated, and remaining stands are poorly stocked with trees. Some people in this area believe that grazing is more profitable than timber-growing, whereas others hold the opposite view. Still others maintain that cattle and timber production should be combined for greatest total income. Range and forest management research are working together to determine best uses and practices for maximum returns.

CANE RANGE

The cane forage type is most often associated with pond pine in areas burned periodically throughout the past. It also occurs with lowland hardwoods and with loblolly pine on moist sites. Cane sites are usually wet much of the year, but during occasional droughts fire hazards are extreme because of the density and height of the cane and associated shrubs. Forage values are also high. Consequently, grazing in this type can be profitable and at the same time beneficial to the forest.

Progress in Cane Management

From early colonial times cane has been recognized as one of the best types of native forage in the Southeast, but its growth requirements have not been well understood. Flowering and seed production are unpredictable--occurring after an indefinite period of years or decades. Furthermore, natural seedling establishment apparently is rare--the only published record of its occurrence, so far as we know, was from our North Carolina studies. Once eliminated, the chances for natural re-establishment of cane stands seem remote. Therefore, present stands of this valuable forage warrant proper management.

Previous experience had shown that cane is readily weakened and killed by overgrazing, but until published this year, specific guides to proper grazing were not available. Studies have shown that at least 40 to 45 percent of the foliage must be left unutilized at the end of the grazing season if cane vigor is to be maintained under continuous summer grazing. With continuous grazing, however, local overgrazing and range deterioration is difficult to avoid. Current results indicate vigor is more easily maintained with rotational grazing.

Cane Range is Highly Productive

An example of very profitable forest grazing from cane range in eastern North Carolina is shown in results published in 1953. Annual beef gains averaged 111 pounds per acre (for a 7-month season) under the optimum grazing rate for sustained forage production. Cows subsisted entirely on native forage three-fourths of the year, and produced 80-90 percent calf crops with calves weighing 370-400 pounds at weaning time. As an additional grazing benefit, total fuel was reduced 70 percent (from 14 to 4 tons per acre) by heavy grazing, and almost 50 percent by moderate grazing. These results obtained on non-stocked forest land suggest possibilities for immediate returns from such land while a forest is being re-established, and also for reducing the critical fire hazard which previously has discouraged reforestation in this area. These cattle returns, however, were better than average and required proper management of both range and cattle.

Cane Response to Fire

Interest in silvicultural applications of fire in forest types associated with cane is increasing. In fact, burning has been found essential for adequate regeneration of pond pine. How burning affects the cane stand is now being studied. Previous information showed that frequent burning decreased forage production. On the other hand, observations indicate that after about 10 years of fire protection cane stands get taller but tend to thin out and become less productive. In such cases winter burning will greatly increase the number of stems and decrease their height, but forage yields will be increased only if the cane is vigorous. Where cane had been weakened by previous heavy grazing, yields were further reduced by burning. How burning affects chemical composition and digestibility of the forage will also be determined in cooperative studies now under way. Experience obtained during the burning operation indicated that fire could be handled satisfactorily in the cane type at a burning index of 10 (meter type 5-W), but under more severe conditions cane fires were very hot and explosive.

Grazed Firebreaks for Wet Sites

During occasional droughts, fire hazard in cane and pond pine sites is extremely high and fires are difficult and dangerous to combat. In these extensive roadless areas, the cane and brush are often head high and very dense. Soft spots, stumps, and down timber make travel even in jeeps impossible. Conditions are so difficult that when fire plows are sent it, two cats usually go together so that one can haul the other out. Thus, fire control would be greatly facilitated by wide firebreaks and emergency access roads. Recently completed research indicates that grazed pasture strips can serve these purposes, and that income from cattle can thus help defray the costs of fire protection. On poorly drained sites, side ditching and slight crowning of the strips were found necessary to prevent the loss of the pasture stand from flooding. Several types of commonly available equipment are suitable for constructing such firebreaks. Common pasture species such as ladino and white clover, big trefoil, tall fescue and orchardgrass proved to be sufficiently fire resistant for this purpose. Aside from the selection of suitable species, the keys to a successful firebreak appear to be good seedbed preparation and adequate fertilization to insure prompt establishment of a pasture sod capable of controlling weed invasion.

WIREGRASS RANGE

The term "wiregrass" is commonly applied collectively to the grasses occurring in the longleaf-slash pine forest type. It is the most important type of forest range in the Southeast from the viewpoint of acreage and cattle numbers.

Wiregrass Range Has Limitations

The value and limitations of wiregrass range are indicated by results of grazing studies published in 1953 as USDA Circular No. 928. The nutritive value of this native forage is very low, especially in fall and winter. Burning increases forage quality and cattle gains during the spring and early summer, and is essential for efficient utilization of this type of range. But even with burning, the nutritional level is not high enough for most cows to breed successfully while nursing a calf. Consequently, one calf in 2 years is the rule, with calves weighing approximately 280 pounds at 7 to 8 months of age. A limited amount of supplemental feeding during fall and winter decreased death losses and increased calf weights, but did not increase calf numbers appreciably. Stocking conservatively on the basis of the burned acreage had a similar influence. Thus, a high-percentage calf crop from wiregrass range apparently depends on supplemental sources of nutrients in summer as well as winter.

Methods of Improving Cattle Performance

Providing a limited amount of improved pasture along with native range appears to be a practical solution to the problem of making effective use of cheap range and at the same time obtaining good cattle production. First-year results with this procedure produced calves approaching the weight of those from pasture herds, and up to 175 pounds heavier than the average calves obtained in previous range studies. Wintering cows at a high nutritional level (but with only range in summer) increased calf weights about

90 pounds over those obtained previously from herds wintered at a minimum level. Other practices are also being used to provide at least 3 levels of nutrition in summer and 2 in winter in order to establish the minimum requirements for high productivity of range herds. The first effects on calving percentage will be obtained next year.

Three years' results from south Georgia show that the quality of range forage can be profitably improved by introducing better forage species into the range. Improvement with lespedeza and carpetgrass has been most profitable, yielding an average of 86 pounds of beef gain per acre. Total improvement costs were equivalent to 46 pounds of beef gain, leaving a net return of 40 pounds of beef per acre annually over a 3-year period. Comparable net returns from unimproved range averaged 14 pounds of gain per acre annually. The improvement consisted of merely broadcasting seed and fertilizer on freshly burned range, and light refertilization annually (200 pounds per acre). More expensive practices involving brush chopping and disking, as well as forage species requiring higher rates of fertilization, gave greater returns per acre but lower net returns per dollar invested in improvements. In order to compare treatments and measure returns accurately, it was necessary to confine cattle entirely to improved range. In practice, greater benefits could be obtained by integrating the use of improved range with native range. The improved portions could well provide firebreak strips.

Tests in south Georgia have shown that revegetated strips offer considerable fire protection. White clover is particularly useful for this purpose because it produces succulent, noninflammable foliage during the winter and early spring in this region. Grazed sods of white clover and carpet or Dallisgrass have provided good fire protection from late January to early November. For the remaining 2 to 3 months, when the grass has been frosted and clover growth is limited, the additional protection of a disked fire line is needed to stop fire-creep even though fuel on grazed sods is scarce and fire control is relatively easy. Since needle cast destroys the effectiveness of disked strips and grazed sods for fire protection, firebreak strips should have no tree cover.

Needle cast also kills out the improved forage stands where tree stocking approaches 50 square feet of basal area per acre. Best grazing results have been obtained where tree basal area was less than 15 square feet. Also, forage yields have been highest on moist lowland sites. All in all, research is showing good possibilities for increased grazing returns from understocked forest land through range improvement, and at the same time obtaining additional fire protection.

Effects of Burning and Grazing Longleaf-Slash Pine Sites

How burning and grazing affect site factors such as vegetative and soil conditions has an important bearing on the question of integrating grazing and timber production. Vegetation responses in south Georgia during 7 years of grazing at full range capacity are summarized in Georgia Coastal Plain Experiment Station Bulletin 51 released in 1953. Soil changes measured after 9 years have been analyzed but not yet published.

Aside from the direct effect on small pine trees, no detrimental influences on understory vegetation were detected--from a forest viewpoint. Burning favored grasses and herbs by removing litter and checking brush growth (in comparison with no burning). With both burning and grazing, the taller bunch grasses decreased, while low-growing grasses and herbs, and also gallberry, increased. Without burning, the grass cover decreased, and brush increased whether grazed or not. The combination of late winter burning followed by season-long grazing reduced herbaceous fuel 70 percent when measured in the fall.

Burning had no significant effect on these sandy soils so far as could be determined from the characteristics studied. Soil organic matter, pH, phosphate, and potash content, volume weight, infiltration and percolation rates, and water-holding capacity were essentially the same after 8 years of burning as after a similar period of fire protection (following previous periodic burning).

Grazing, likewise, had no detectable effect on the chemical constituents of the soil. However, grazing did influence physical characteristics significantly. Volume weight of the top 3 inches of soil was increased 5 percent, and infiltration and percolation rates were decreased about 60 percent. Water-holding capacity was decreased 4 percent. These measurements reflect slight compaction of the surface soil from trampling. However, infiltration and percolation were moderately rapid, even under the grazed condition. Therefore, effects of grazing in relation to water intake or runoff would seem to be of minor importance on these sandy and level soils. Influences on soil aeration were not measured.

FOREST DISEASE RESEARCH[1/]

Littleleaf Disease of Pine

Much experimental evidence indicates that the littleleaf disease of shortleaf pine results mainly from nitrogen deficiency of the trees following the destruction of fine roots by Phytophthora cinnamomi in heavy soils. Plots containing littleleaf trees, that have been treated with either 3 or 4 applications of nitrogenous fertilizers over a period of 10 to 12 years continue to hold their own or improve, while those that have received other amendments, but very little or no nitrogen, have continued to decline.

Emphasis during 1953 has been put on the selection and propagation of shortleaf pines apparently resistant to littleleaf. Some crossing and inbreeding was done among eight such trees, yielding a small quantity of seed. Scions from these pollinated trees were also grafted on 2-year stocks and later set out to provide future breeding material and a seed orchard. In three States, three 2-acre areas from which littleleaf trees had been removed were planted with 12 geographic lines of shortleaf pine to compare their littleleaf resistance.

[1/] Report of the Division of Forest Disease Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, in cooperation with the Southeastern Forest Experiment Station.

Comprehensive analyses on soil-nutrient relations, oxidation-reduction potential, and other soil factors not previously studied in relation to littleleaf have been under way. A 5-year shortleaf study involving artifically induced drought has provided strong evidence that some littleleaf-like symptoms can result from low soil moisture, but the symptom picture as a whole is different from littleleaf.

Oak Wilt

Aerial and ground surveys in 1953 brought the total counties where oak wilt has been found in the Southeast (table 9) to the following: Virginia 5, compared with 1 in 1952; Kentucky 4, compared with 3; Tennessee 8 versus 6; and no change in the other States. Good progress toward the removal of diseased trees has been accomplsihed in all of the southeastern States where oak wilt occurs, except in Tennessee. Local spread had taken place since 1952 in the case of 6 out of 16 areas observed.

Table 9.--Known distribution of oak wilt in southern Appalachian area up to September 1953

State	Counties with wilt	Infection centers found		
		1951	1952	1953
	Number	Number	Number	Number
Kentucky	4	1	1	4
North Carolina	3	10	6	7
Tennessee	8	13	6	30
Virginia	5	1	0	11

Spraying felled, unbarked, oak-wilt trees with a BHC-DDT-Penta mixture greatly reduced but did not eliminate fungus-mat-inhabiting insects on diseased trees. Five of the 29 wilting trees studied in 1953 developed fruiting mats of the fungus in the fall. The mats totaled 5-1/2 square feet of fruiting surface, from which 611 insects, mostly Nitidulid beetles, were collected. These beetles have been proven by others to be capable of inoculating healthy trees through wounds. Current studies in which Nitidulids were released 100 and 500 feet from down trees with oak wilt mats have shown some of these beetles to be attracted to the mats over both distances.

Studies during 1953 also showed that infection can originate in the upper branches of large trees.

Nursery Diseases

Visits were made to 4 Georgia nurseries at 3-week intervals during the growing season and also occasionally to other southeastern nurseries. Root rot, possibly of nematode origin, was common and studies were begun to obtain a satisfactory treatment. Nutritional problems were of major importance. Nitrogen deficiencies were corrected by spraying with urea at 50 pounds per acre. Iron deficiencies were corrected by iron chelate sprays at 20 pounds per acre. Phomopsis blight of Arizona cypress and redcedar was severe and studies were begun on sprays and seed treatments. Defects in watering procedures at some nurseries were turned up and measures were taken to correct them.

Mimosa Wilt

Two chemicals, Vancide 51 and Dithane D-14, gave 2-month-old mimosa seedlings some protection against the wilt disease in 1952 greenhouse tests. Additional greenhouse tests in 1953 indicated that these chemicals and a mixture of Puratized Agricultural Spray and ferbam are worth further study, as they reduced the incidence of wilt among seedlings. Vancide and Dithane were also applied in the field to soil around sapling mimosas that were later inoculated artifically--with inconclusive results.

Loblolly Pine Spot Die-Out

A survey was conducted in South Carolina to determine the nature and extent of many failures in 10- to 15-year-old loblolly plantations on federal, state, and private lands. Reports as early as 1948 suggested heavy mortality in certain plantings following an initial period of satisfactory establishment and growth. The dying of patches from 1/10 to 25 acres in extent was found to be common on certain sites and soil conditions in many plantations established in central South Carolina. Most of this decline and mortality has taken place in the last 3 years. Preliminary field observations indicate that mortality is greatest on flats or slight slopes and on soils with poorly drained subsoils possessing little or no topsoil. These observations also suggest that limited returns can be expected from a considerable acreage of loblolly plantations made in the past 15 years. Increasing numbers of such rapid loblolly failures are being reported and studied.

Virginia Pine Rust

This newly described rust (Peridermium appalachianum), discovered in 1948 (fig. 15), is now known in 15 counties in Virginia, Kentucky, North Carolina, and Tennessee. While observers report it to be increasing, and it is a killing disease, it is not yet an economic factor. Life history studies in 1953 involved making aeciospore inoculations on Virginia, shortleaf, and loblolly pine to determine whether the rust is autoecious, and something about its host relations. Later in the season a Cronartium was found on the leaves of the uncommon shrub Buckleya distichophylla, and inoculation attempts were made on the above 3 pine species, using germinating teliospores of the Buckleya rust. Two years will be required to evaluate these results.

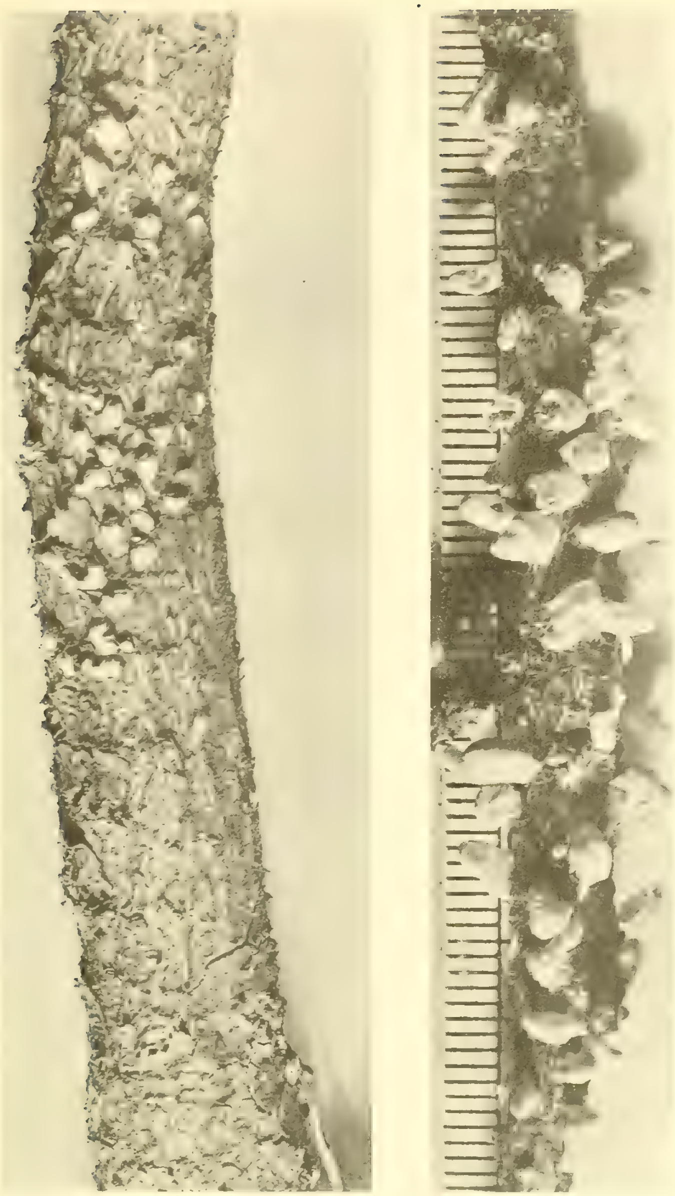


Figure 15.--*Peridermium appalachianum*, a recently discovered stem rust on Virginia pine. In appearance and manner of attack it resembles blister rust on white pine. At left, an infected branch, showing aecial blisters. At right, close-up of blister stage, with scale in millimeters.

Fomes Annosus Root Rot on Slash Pine

Although *Fomes annosus* is known to cause serious root and butt rots in many coniferous species in the United States and abroad, no cases of important damage to the southern pines were reported until 1953. Recently two pole-sized slash pine plantations--one in Georgia and one in South Carolina--have been found to have severe root rot leading to breaking over, and to some killing of trees. These examples of *F. annosus* aggressiveness in pole-sized slash pine plantations must be watched with care, especially since thinning tends to increase *annosus* damage. This development, plus the loblolly spot die-out situation, shows that plantations cannot be fully evaluated until they reach minimum merchantable size.

Other Pathology Problems

A large Chinese chestnut plantation was established at Bent Creek, comparing five of the best available strains, in randomized-block design, on two sites.

In a service project to the Navy, 300 wooden boats of 14 different types were examined for rot. Some came from active and inactive ships, and some were stored ashore. A report was submitted, giving suggestions for considerably reducing decay in such boats. Supervision of dip and brush preservative treatments was also provided several yards, and special studies were conducted on mine sweepers and on methods of dehumidification.

The pine leaf blight caused by Hypoderma lethale was effectively controlled by spraying with ferbam weekly from May 29 until August 14. Fewer sprays may also provide control.

In 1953, 299 disease inquiries were handled at Asheville, not counting the oak wilt survey. This compares with 143 in 1950, and 99 in 1947. Handling inquiries has become a major function.

Plans

Plans for 1954 include the following: selection and breeding for littleleaf resistance, and completion of the work on soil, soil oxygen, and littleleaf incidence; the fruiting habits of the oak wilt fungus and their relation to control; further surveys for oak wilt and supervision of control work; a broad attack on the major tree nursery diseases in Georgia and Florida; further inquiry into spot die-out of loblolly and Fomes annosus attack of slash pine; further testing of the possible hosts of the new Virginia pine rust; follow-up on sugar maple sapstreak; maintenance of a large number of plots in connection with littleleaf, blight-resistant chestnuts, mimosa wilt, and oak decay; and continued service to the Navy on decay in wooden boats.

FOREST INSECT RESEARCH[2]

Forest insect activity in the Southeast has increased considerably during the past few years. Previous to 1950, foresters in this area reported few serious forest insect losses for a decade or more. Commencing in 1950, attacks by such insects as the black turpentine beetle, southern pine beetle, and Ips engraver beetles have increased and killed millions of feet of timber; defoliation by such insects as cankerworms, forest tent caterpillar, variable oak leaf caterpillar and pine sawflies stripped foliage from hundreds of thousands of acres of forests, causing growth loss and greater susceptibility to attack by secondary insects. Sucking insects such as Pineus pinifoliae, scales, and aphids became prevalent and caused serious injury. This increased activity by insects occurred during a period of intensification of regional forestry practices and when forest insect survey activities were being initiated under provisions of the Forest Pest Act.

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[2] Report of the Division of Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, in cooperation with the Southeastern Forest Experiment Station.

The need for protecting forests from insects is shown by the growing list of private, state, and federal agencies which have requested assistance on methods of preventing or reducing losses caused by insect attack on trees, logs, pulpwood and wood products. At the present time at least two private companies in the region have streamlined their woods practices so that they can salvage single, insect-attacked trees. There is no doubt that increased utilization of insect-killed material will continue.

Southern Pine Beetle

Reports that the southern pine beetle, Dendroctonus frontalis, was killing trees on the Chattahoochee National Forest in December 1952 were investigated. Surveys by aerial and ground methods indicated that 60 acres containing about 300 M feet had been killed by the southern pine beetle in 40 scattered locations. Investigations in 1953 indicated that the infestation was subsiding.

In August 1953 an increase in activity of the beetle was noted throughout western North Carolina and eastern Tennessee. This fact was called to the attention of forest owners in the area. Aerial and ground surveys demonstrated that kills were doubling with each generation of beetles. Ground surveys in the Tennessee portion of the Great Smoky Mountains National Park indicated that 750 trees were infested in Cades Cove. An additional 900 trees were estimated infested in the Park in North Carolina, on the Cherokee Indian Reservation, and on the Blue Ridge Parkway. In most locations the infestations occurred on very rocky, steep slopes, thereby lessening the possibilities of salvage.

Infestations of this beetle were also located on the French Broad and Catawba districts of the North Carolina National Forest. Aerial and ground surveys indicated that 1,500 pines were infested on the French Broad District early in September and that 6,000 were infested in the Catawba area. A recommendation was made on September 11 that these infestations be controlled as soon as possible.

Ground and aerial surveys in December indicated that individual beetle kills in the mountain region varied from a few trees up to 25 acres. At the end of the year it was estimated that a total of over 1,000 acres had been killed in patches which were over 1/2 acre in size. There was an aggregate of several hundred additional acres in kills of less than 1/2 acre.

Black Turpentine Beetle

During the years 1950-52 the black turpentine beetle, Dendroctonus terebrans, and Ips engraver beetles increased to epidemic proportions in northeast Florida and killed an estimated 25,000 M feet of pine. Aerial and ground surveys in the fall of 1952 and spring of 1953 in cooperation with the state of Florida indicated that stumps and trees infested last fall showed less beetle emergence this spring because of competition by wood borers, termites, molds and fungi. Our surveys indicated that beetle populations were rapidly returning to endemic conditions and that special control measures beyond salvage were not justified.

This beetle has continued to be a serious problem on the Osceola National Forest since 1950, when it became active and began killing naval stores timber located in ponds, which were exceptionally dry at that time. Salvage of infested timber did not control the beetle, and appeared to aggravate the infestation. Salvage sales in 1950 totalled 827 M feet. During 1951, salvage sales amounted to 1,463 M feet. Efforts to control the beetle through use of penetrating toxic oil sprays containing 0.5 percent gamma benzene hexachloride commenced in December 1951. Losses to April 1952 exceeded 25 percent of the timber being turpentined and six crops (10,000 faces each) were lost. Salvage sales continued in 1952, during which period 7,392 M feet of pine was marked and sold. Up to January 31, 1953, 65,000 stumps and 6,500 seed trees had been sprayed. During 1953 about 10,000 M feet of pine is expected to be sold. Control measures are continuing on the Osceola National Forest. These measures at present consist of spraying seed trees with 0.5 percent gamma benzene hexachloride in fuel oil. Stumps are being peeled and the root collar sprayed with the 0.5 percent gamma BHC plus one-third pound of ethylene dibromide per gallon of fuel oil.

Ips Engraver Beetles

Drought conditions continued to prevail in the Southeast throughout most of 1953. Such conditions appear to favor the build-up of serious bark beetle populations. Ips bark beetles generally attack scattered trees throughout the stand, and damage does not appear to be serious. The damage is, therefore, not reported and no record is made of it. In the aggregate, however, the losses caused by Ips bark beetles are extremely serious as interpreted from information collected by the Division of Forest Economics, Southeastern Forest Experiment Station. Of over 212,000 M feet which were estimated to have been killed annually by insects in the Southeast (including Tennessee and Kentucky) during the past 3 years, about 90 percent or over 190,000 M feet with a stumpage value of over $4,750,000 was estimated to have been killed by Ips beetles.

Hickory Bark Beetle

Hickories throughout central North Carolina from Shelby to High Point were attacked and killed by the hickory bark beetle, Scolytus quadrispinosus. Killing of trees was especially common during the fall months when trees were observed dying in considerable numbers in farmers' woodlots and around homesites. Drought conditions, generally characteristic at the time when attacks by this beetle occur, were prevalent throughout the area of beetle activity.

Fall Cankerworm

An aerial survey of 2,000,000 acres of hardwood forests in the Southern Appalachian Mountains was made in May 1953. This survey located 63 areas of defoliation by the fall cankerworm, Alsophila pometaria. The comparative areas of defoliation since the infestation began 2 years ago indicate that defoliation increased from 15,000 acres in 1952 to over 120,000 acres in 1953.

Of the latter amount, 29,495 acres were heavily defoliated. The area heavily defoliated in 1953 was eight times greater than the previous year. This increase closely corresponded with an increase in the number of egg masses deposited.

The principal natural controls observed in 1953 were a late frost on April 26, which killed 21 percent of the potential larval population; a decrease in viability of the eggs from 80 percent in 1952 to 51 percent in 1953; and action of predatory Calasoma beetles and pentatomid bugs feeding on the larvae. Natural factors were not effective in controlling the 1953 infestation.

Two years of defoliation has not killed the trees. However, defoliation has weakened them and resulted in trees being only partially refoliated with undersized leaves. Control operations have been recommended for the aerial spraying of 500 acres of Mount Pisgah with DDT.

Sawflies

A sawfly, Neodiprion dyari, was reported as causing defoliation in Marion County, Florida, early in February. Another Neodiprion defoliated scattered pond pine in March on 23,000 acres in Berkeley County, South Carolina. Defoliation of 50 acres of pond pine in the South Carolina area was first noted about 1946. Since then this sawfly has reportedly spread over thousands of acres. Defoliation by the sawfly has apparently not been responsible for tree mortality, although the annual loss of needles has undoubtedly caused considerable growth loss. Limited observations to date indicate that dipterous and hymenopterous parasites are exerting a considerable degree of control. Another species, Neodiprion americanum, defoliated small areas of loblolly pine during the month of June from Virginia to Georgia. Early in October scattered defoliation by the red headed pine sawfly, Neodiprion lecontei, occurred on several hundred acres near Lake City and in Hillsboro County, Florida. Complete stripping of small groups of trees was noted throughout northeastern Florida on this latter date.

Variable Oak Leaf Caterpillar

The variable oak leaf caterpillar, Heterocampa manteo, was reported to have defoliated hundreds of thousands of acres of oak and hickory in central and western Tennessee. This species also caused stripping of oak on thousands of acres in western Kentucky around Kentucky Lake.

Nantucket Pine Moth

The Nantucket pine moth, Rhyacionia frustrana, and another species, R. rigidana, continued, as in previous years, to be serious pests of young pine throughout the Southeast from Virginia to Florida. Studies on the effect of tip moth attack on height growth and on control measures were initiated in 1953 at Union, South Carolina. In many areas, especially of loblolly pine, nearly every leader was attacked during the fall months.

Pales Weevil

The Pales weevil, Hylobius pales, and a closely related species, Pachylobius picivorous, are pests of considerable importance to pine reproduction in the Southeast, although they are not generally recognized as such. The adults of these weevils alone or in conjunction with those of cerambycid and buprestid larvae are able to kill pine reproduction by feeding on the bark of seedlings and girdling them. The greatest amount of injury occurred on and adjacent to areas which had been logged, beetle-killed, burned, or windthrown. Beetles are attracted to this type of material previous to oviposition and following emergence of adults from pine stumps where they breed. Plantings of pine within one year of logging are likely to suffer considerable mortality from attack by these pests. Killing of especially valuable planting stock at Union, South Carolina, by these beetles was prevented by the application of DDT spray to the seedlings.

White Grubs

White grubs, Phyllophaga spp., have been considered to be serious pests in forest tree nurseries in this area for some time but seldom have they been reported as serious pests of either natural or planted stock. A report of serious injury to planted stock on extensive areas at the Savannah River Project in South Carolina was investigated in October. White grubs were found to have caused serious injury to the roots of loblolly, slash, and longleaf pine seedlings planted early in 1953. Sampling of the injury over the 10,000 acres indicated that white grubs in combination with dry weather had caused mortality varying from 5 to 100 percent. There is little doubt that a mortality of several million seedlings occurred. Planting of this year's stock commenced on November 16. Plans were formulated to dip the roots of 10 million seedlings in an organic insecticide prior to planting and to conduct a screening test of several additional insecticides to determine their value in providing protection of the planting stock from grub injury.

PUBLICATIONS

by

MEMBERS OF THE STAFF, INCLUDING COOPERATORS

Calendar Year 1953

ALDRICH, R. C.
Aerial photographs and the forest survey. The Cypress Knee. Univ. Ga., School Forestry 29: 46, 59, 60.

Use and limitations of aerial photographs on extensive forest surveys.

ALDRICH, R. C.
Accuracy of land-use classification and area estimates using aerial photographs. Jour. Forestry 51(1): 12-15. Jan.

An analysis of how accurately land use can be classified on aerial photographs and what intensity of ground checking is needed to achieve the accuracy required.

BARBER, J. C.
Tree planting at the Bent Creek Experimental Forest. Southeast. Forest Expt. Sta. Station Paper 27. 11pp. Aug.

A report on the survival and growth of experimental plantings, including the arboretum established in 1926.

BENNETT, F. A.
Topwood volume tables for slash and longleaf pine. Southeast. Forest Expt. Sta. Research Note No. 42. July.

Tables of cordwood volume in tops of sawlog trees are given for turpentined and round longleaf and slash pines in the upper Coastal Plain of Georgia.

BENNETT, F. A.
Site indexes of the soil series on the George Walton Experimental Forest. Southeast. Forest Expt. Sta. Research Note No. 34. May. Also, with title Drain sites best for slash pine, in Naval Stores Rev. 63(19): 22. Aug. 22.

Exploratory study of site index and soil series in south Georgia shows that poorly drained soils are better sites for slash pine. On identical soils, slash pine shows a higher site index than longleaf pine.

BOYCE, J. S., Jr.
Needle blights of pines in the Southeast. Arborist's News 18(10): 89-91. Oct.

Describes the symptoms and control of several common needle diseases of yellow pines in the Southeast.

BOYCE, J. S., Jr., and GARREN, K. H.
Compatibility types of the oak wilt fungus in 23 Appalachian trees. Phytopath. 43(11): 644-645. Nov.

Cultures from oak wilt trees made in 1952 showed that most trees are infected with only 1 of the 2 compatibility types of the fungus and thus cannot produce the sexual stage spores unless mating of the A-type and B-type takes place between trees. The study also established that infection can take place in the upper tree crown.

BURKS, G. F., TODD, A. S., Jr., and HAIR, D.
Trends in pulpwood supplies in the United States. The Paper Industry 35(9): 982-987. Dec.

Softwood timber in Alaska and the Rocky Mountains, as well as hardwoods, cull trees, and sawmill residues in all regions, can provide raw material for continued expansion of the pulp and paper industry.

CAMPBELL, R. A.
Logging methods and costs in the Southern Appalachians. Southeast. Forest Expt. Sta. Station Paper No. 30. 29pp. Oct.

A report on a comprehensive study of the variables affecting logging costs in typical mountain topography and a summary of costs for typical operations.

CAMPBELL, R. S., and SHEPHERD, W. O.
Forest grazing in the Southeastern United States. Sixth International Grassland Congress Proc. pp. 1550-1555. 1952, pub. 1953.

General situation review; major forest range types and species, grazing capacity and forage values, season of use, problems and opportunities.

CAMPBELL, W. A., and COPELAND, O. L., Jr.
Littleleaf disease. Amer. Forests 59(6): 23, 51. June.

A brief general account of the symptoms, cause, distribution, and soil relations of littleleaf.

CAMPBELL, W. A., COPELAND, O. L., Jr., and HEPTING, G. H.
Littleleaf in pines in the Southeast. In Plant Diseases, Yearbook of Agriculture 1953, pp. 855-857. U. S. Dept. Agr., Washington, D. C.

A brief general account of the symptoms, cause, distribution, and soil relations of littleleaf, with suggestions for reducing losses.

CAMPBELL, W. A., COPELAND, O. L., Jr., and HEPTING, G. H.
Managing shortleaf pine in littleleaf disease areas. Southeast. Forest Expt. Sta. Station Paper No. 25. June.

A resumé of that part of the results of 15 years of research on littleleaf that deals with field behavior, site, and soil factors, salvage, stand management, and other aspects of practical forest management in littleleaf areas.

CLEMENTS, R. W.
The bark hack. Naval Stores Rev. 62(42): 12-13, 27-28. Jan. 17. Also, with title Training the chipper to use the bark hack, in AT-FA Jour. 15(5): 12-13, 15. Feb.

Gum producers converting to bark chipping should train woods labor in the proper use of a bark hack. Training methods are discussed.

CLEMENTS, R. W.
Correct use of the spray gun. Naval Stores Rev. 62(51): 16-17. March 21. Also, with title Correct use of the acid spray gun, AT-FA Jour. 15(8): 8-9, 11. May.

Good acid treatment requires correct amount of acid and correct placement on the streak. Discussion tells proper methods for obtaining both.

CLEMENTS, R. W.
How to install spiral gutters with double headed nails. AT-FA Jour. 16(2): 4. Nov. Also, with title How to install spiral gutters, in Naval Stores Rev. 63(21): 14, 15. Oct. 17.

Spiral gutters attached with double-headed nails increase the yield of gum, are easily installed and removed, and do not damage the tree. Instructions for installation include photographs.

COOPER, R. W.
Prescribed burning to regenerate sand pine. Southeast. Forest Expt. Sta. Research Note No. 22. Jan. Also in South. Lumberman 186(2331): 50. May 15.

Early response to prescribed burning indicates that more information is needed on the time of year to burn, on the interval between cutting and burning, and on the number of seed trees.

COOPER, R. W.
Keeping sand pine woodlands in production. South. Lumberman 187(2345): 154-155. Dec. 15.

To keep sand pine stands in production, clearcutting in the fall or early winter is recommended, and should be followed by tractor skidding to prepare a suitable seedbed.

COOPER, R. W., and SCHOPMEYER, C. S.
Viability of sand pine seed. Southeast. Forest Expt. Sta. Research Note No. 23. Jan.

Viability of sand pine seed retained in cones decreases with age of cone.

CRUIKSHANK, J. W.
Forest survey and timber resources review. Conserv. Congress Proc., N. C. Board of Conserv. and Devlpmt. 1: 103-106. 1952, pub. 1953.

Description of national forest survey, methods used in North Carolina and data obtained. Also brief description of the several phases of The Timber Resource Review of the Forest Service.

CRUIKSHANK, J. W.

Labor requirements in forestry and forest industry. In Research in the Economics of Forestry, pp. 121-127. Charles Lathrop Pack Forestry Foundation, Washington, D. C.

Procedure to be used in determining the labor required for specific forest management and timber harvesting operations.

DEMMON, E. L.

Georgia's forest survey shows new trends. The Paper Industry 35(2): 188-190. May.

Changes in the supply and quality of the timber resource are revealed. Recommendations are made for needed changes in timber utilization, forest practice, and forest research program.

DEMMON, E. L.

Forest research and its relation to the wood-using industries in the Southeast. Jour. Forest Prod. Res. Soc. 3(2): 10-12, 85. June.

Highlights of research at the Southeastern Forest Experiment Station and its eight centers, with particular emphasis on utilization. Finding new uses and markets for low-grade hardwoods, developing and growing better trees, expanding research in anticipation of demands by wood chemical industry.

DEMMON, E. L.

Trends in southern hardwood forestry. South. Lumberman 187(2345): 174-177. Dec. 15.

Interest in hardwood management, uses, markets, and research is rising throughout the region.

DILS, R. E.

Influence of forest cutting and mountain farming on some vegetation, surface soil and surface runoff characteristics. Southeast. Forest Expt. Sta. Station Paper No. 24. 55pp. June.

Reports a watershed experiment where the original hardwood forest was cleared and the land used as a mountain farm.

DOOLITTLE, W. T.

Growth and survival of hybrid poplars. South. Lumberman 187(2345): 178-179. Dec. 15.

Experimental plantings of 12 hybrid poplar clones set out in 1935 show that juvenile growth of certain clones compares favorably with rapid-growing native species.

DORMAN, K. W.

A taxonomic study of slash pine. (Abs.) Assoc. South. Agr. Workers Proc. 50: 116-117.

Slash pine, one of the most valuable southern pines, is a distinct species from Caribbean pine, with which it has usually been united. The related pine of southern Florida is now recognized as a botanical variety.

DORMAN, K. W., BAUER, E., and GREENE, J. T.
Tree improvement makes a step ahead. South. Lumberman 187(2345): 170-171. Dec. 15.

A description of the history and progress of the tree improvement program at the Ida Cason Callaway Foundation, Hamilton, Ga.

ENGLERTH, G. H.
A key to the genera of the gilled fungi. U. S. Dept. Agr., Bur. Plant Indus., Soils, and Agr. Engin., Div. Forest Path. leaflet.

Contains a descriptive key in chart form for the identification of the more common genera of mushrooms.

GREENE, G. E.
Soil temperatures in the South Carolina Piedmont. Southeast. Forest Expt. Sta. Station Paper No. 29. 16pp. Sept.

Measurements are discussed for the upper 6 feet of soil under four cover conditions: 40 and 11-year-old pine, broomsedge, and bare soil.

GRUSCHOW, G. F.
Better woods + $10 a year. The Progressive Farmer 68(1): 81. Jan.

An average flatwoods farm woodland under management yields a gross financial return in 5 years of $62.00 per acre for products at the roadside.

HALLS, L. K.
Improved cattle forage under southern pines. South. Lumberman 187(2345): 218, 220. Dec. 15.

Productivity of introduced forage species in relation to density of the pine overstory. Discussion of promising forage species for range improvement and fire hazard reduction.

HAINES, W. H. B.
86 percent of tops and 54 percent of slabs and edgings unused in central Piedmont of South Carolina. Southeast. Forest Expt. Sta. Research Note No. 35. May.

The quantity and use of logging and sawmill waste.

HAINES, W. H. B.
62 percent of pine lumber is cut from 10-inch or smaller logs in the central Piedmont of South Carolina. Southeast. Forest Expt. Sta. Research Note No. 36. May. Also, with title Sixty-two percent of lumber cut from 10-inch or smaller logs in S. C., in The Unit 49: 11. Sept.

Lumber output by log and tree size.

HAWLEY, N. R.
25-year-old stand shows unusual yield. Forest Farmer 12(7): 10-11. April.

A slash pine plantation in south Georgia returns $7.71 per acre per year during the first 25 years of its life.

HAWLEY, N. R.

Rapid growth of planted slash pine in the middle Coastal Plain of Georgia. Southeast. Forest Expt. Sta. Research Note No. 32. May. Also, with title Growth of planted slash pine in Georgia, in South. Lumberman 187(2334): 60. July 1. Also, with title Rapid growth of planted slash pine, in The Unit 49: 8. Sept.

Over the 18 years since planting, the Stephens plantation near Cordele, Ga., has averaged 1.74 cords per acre per year. Sawtimber production over the same period is 370 board feet per year.

HAWLEY, N. R.

Merchantable height greater after improvement cut in pilot-plant management test. Southeast. Forest Expt. Sta. Research Note No. 33. May.

The first improvement cut in young longleaf-slash pine sawtimber increased average merchantable heights by 2-1/2 feet, and volume of average trees by 10 percent.

HEPTING, G. H.

Diseases of forest trees in Virginia. Va. Forests 8(5): 8-10. Sept.-Oct.

Major forest tree diseases in Virginia.

HEPTING, G. H.

Forest tree diseases in North Carolina. Conserv. Congress Proc., N. C. Board of Conserv. and Devlpmt. 1:89-92. Nov. 1952, pub. 1953.

A digest of the major forest diseases in North Carolina, the losses they cause, present status, and progress being made toward their solution. The diseases featured are chestnut blight, oak wilt, littleleaf, fusiform rust, brown spot, and the cull problem.

HOOVER, M. D.

Interception of rainfall in a young loblolly pine plantation. Southeast. Forest Expt. Sta. Station Paper 21. 13pp. Jan.

In a two-year study 12 and 16 percent of the annual rainfall was intercepted by the tree canopies and did not reach the ground. Of the amount reaching the ground one-fifth was measured as water flowing down the tree trunks.

HOOVER, M. D., OLSON, D. F., Jr., and GREENE, G. E.

Soil moisture under a young loblolly pine plantation. Soil Sci. Soc. Proc. 17(2): 147-150. April.

In a 2-year study using fibreglas electrodes it was found that pine roots depleted soil moisture to a depth of at least 5-1/2 feet, bringing it to wilting point in August 1951. In March 1952 when at field capacity the same soil depth had stored nearly 10 inches of rain as soil moisture.

HURSH, C. R.
Forest management in East Africa in relation to local climate, water and soil resources. East African Agr. and Forestry Res. Organ. Ann. Rpt. 1952, pp 26-35.

Good forestry is the key to improving and conserving the local climate, water, and soil resources of East Africa.

HURSH, C. R., and PEREIRA, H. C.
Field moisture balance in the Shimba Hills, Kenya. East African Agr. Jour. 18(4): 1-7. April.

For the equatorial coastal conditions studied, a high tropical forest was considered to be more favorable to ground-water storage than the adjacent, annually-burned grass vegetation.

JENKINS, A., MILLER, J. H., and HEPTING, G. H.
Spot anthracnose and other leaf and petal spots of flowering dogwood. The Natl. Hort. Mag. 32: 57-69. April.

Describes several common dogwood blights and means of control. Well illustrated. The first such treatment given to dogwood diseases.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Maine. Southeast. Forest Expt. Sta. 70pp. July.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in New York. Southeast. Forest Expt. Sta. 32pp. July.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Vermont. Southeast. Forest Expt. Sta. 20pp. July.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Pennsylvania. Southeast. Forest Expt. Sta. 78pp. Aug.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in New Hampshire. Southeast. Forest Expt. Sta. 29pp. Aug.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Connecticut. Southeast. Forest Expt. Sta. 22pp. Sept.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in New Jersey. Southeast. Forest Expt. Sta. 29pp. Sept.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Maryland. Southeast. Forest Expt. Sta. 34pp. Oct.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Kentucky. Southeast. Forest Expt. Sta. 42pp. Nov.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Massachusetts. Southeast. Forest Expt. Sta. 36pp. Dec.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in Virginia. Southeast. Forest Expt. Sta. 61pp. Dec.

Tables and graphs analyzing forest fires and fire danger.

KEETCH, J. J., and GLADSTONE, M. C.
1952 forest fires and fire danger in West Virginia. Southeast. Forest Expt. Sta. 49pp. Dec.

Tables and graphs analyzing forest fires and fire danger.

LARSON, P. R., and CLEMENTS, R. W. More gum without broadaxe incisions. Naval Stores Rev. 63(20): 12, 13. Sept. 19. Also in AT-FA Jour. 16(1): 8, 9. Oct.

Gum yields of longleaf pine have been increased by as much as 60 barrels per crop merely by nailing-on gutters and aprons instead of inserting tins in broadaxe incisions.

LARSON, P. R.
Early season streaks unprofitable. Naval Stores Rev. 63(19): 20, 21. Aug. 22. Also in AT-FA Jour. 16(1): 15. Oct.

Yield of individual streaks weighed for nine different studies on slash pine over a 5-year period show that low profit in marginal timber may be caused by low yields of the early and late season streaks.

LARSON, P. R.

Turpentine trees remain healthy after nine years of acid work. South. Lumberman 187(2345): 214, 216. Dec. 15. Also in Naval Stores Rev. 63(23): 12, 13. Dec. Also in AT-FA Jour. 16(3): 4, 5. Dec.

Gum yields of both untreated, wood-chipped and acid-treated, bark chipped slash pine showed no appreciable decline during 9 years of work.

LINDENMUTH, A. W., Jr.

How dry were southern Appalachian forests in the fall of 1952. Southeast. Forest Expt. Sta. Research Note No. 24. Jan.

An analysis of rainfall, cumulative danger index, lower litter moisture, and burning index records indicated extremely severe burning conditions during the period October 17 - November 8.

LINDENMUTH, A. W., Jr., and KEETCH, J. J.

Fire prevention efforts pay off in the Northeast. Fire Control Notes 14(1): 14-16. Jan.

The frequency of forest fires in 13 Northeastern States dropped about one-half during the period 1943-1950. The method of analysis takes out the effect of weather so the reduction can be attributed largely to more effective prevention efforts.

LINDENMUTH, A. W., Jr., and KEETCH, J. J.

1951 forest fires and fire danger in New York. Southeast. Forest Expt. Sta. 34pp. Feb.

Tables and graphs analyzing forest fire and fire danger.

LINDENMUTH, A. W., Jr., and KEETCH, J. J.

1952 forest fires and fire danger in Rhode Island. Southeast. Forest Expt. Sta. 17pp. June.

Tables and graphs analyzing forest fire and fire danger.

LINDENMUTH, A. W., Jr., and KEETCH, J. J.

Fire frequency as a measure of fire prevention accomplishments. Southeast. Forest Expt. Sta. Research Note No. 37. July.

1951 fire occurrence in 13 Northeastern States was lower than might reasonably have been expected when the severity of the weather is taken into consideration.

LOTTI, T.

Good seed trees pay off. South. Lumberman 187(2336): 43-44. Aug. 1.

Leaving 4 to 12 seed trees per acre on a 200-acre logging chance in coastal loblolly pine resulted in 85 to 90 percent milacre stocking 3 years after logging.

MCCLAY, T. A.
Estimating board widths obtainable from pine trees of different diameters. Southeast. Forest Expt. Sta. Research Note No. 25. Jan.

Offers a means by which percentage of 1-inch boards of 4- to 12-inch widths in trees ranging from 10 to 24 inches d.b.h. may be estimated from a timber cruise. Quoted percentages are substantiated by ten actual operations.

MCCLAY, T. A.
Estimating time requirements for tree poisoning with Ammate. Southeast. Forest Expt. Sta. Research Note No. 27. Jan. Also in Jour. Forestry 51(12): 909. Dec.

The time required to poison inferior dominant hardwoods is shown to be correlated with the number of stems to be treated and the sum of their diameters.

MCCLAY, T. A.
Relation of tree size to production rates when cutting pine pulpwood with a chain saw. Southeast. Forest Expt. Sta. Research Note No. 28. Jan.

The effect of tree size upon felling and bucking time for pine pulpwood is shown by comparing the time cost for a 10-inch, 7-bolt tree with all other sizes. Man-hour costs are also given by tree diameter classes.

MCCLAY, T. A.
The relation of growth to severity and season of pruning open-grown loblolly pine. Jour. Forestry 51(4): 287-288. April.

Pruning to one-half and two-thirds total height in summer and winter showed that diameter growth is significantly reduced by increasing severity of pruning, but is not affected by season of treatment. Height growth was not affected by either severity or season.

MCCLAY, T. A.
Growth, mortality, and regeneration after cutting in loblolly pine pulpwood stands. Southeast. Forest Expt. Sta. Station Paper No. 28. 15pp. Sept.

Heavy thinning from below in 25- to 30-year-old loblolly pine produced greater returns in the decade after cutting than moderate thinning from below, seed-tree, shelterwood, or diameter-limit cutting.

MCCORMACK, J. F.
Forest statistics for central Georgia, 1952. Southeast. Forest Expt. Sta. Forest Survey Release No. 40. 44pp. July.

Forest area, timber volume, growth and drain statistics and trends in timber volume.

MCCORMACK, J. F.

D.b.h. in relation to stump diameter at various heights for southern yellow pines and hardwoods. Southeast. Forest Expt. Sta. Research Note No. 43. July.

A table showing tree diameter outside bark at 4.5 feet above ground in relation to stump diameter at various heights.

MCCORMACK, J. F.

Forest statistics for the southern Coastal Plain of North Carolina, 1952. Southeast. Forest Expt. Sta. Forest Survey Release No. 41. 45pp. Sept.

Forest area, timber volume, growth, and drain statistics and trends in timber volume.

MCCULLEY, R. D.

Controlling seed production and seed utilization in loblolly pine. (Abs.) Assoc. South. Agr. Workers Proc. 50: 117-118.

Suggested management practice to insure natural reproduction includes short cutting cycles, proper timing of the cut to coincide with good seed years, stimulation of seed production by preharvest release, and seedbed preparation.

MCCULLEY, R. D.

The case for even-aged management of southern pine. Jour. Forestry 51(2): 88-90. Feb.

A defense of even-aged management, presented at the symposium on all-aged vs. even-aged management of southern pines during the 1951 SAF Meeting at Biloxi, Mississippi.

MCCULLEY, R. D.

Estimating growing space liberated by the removal of residual hardwoods. Southeast. Forest Expt. Sta. Research Note No. 31. May. Also in Naval Stores Rev. 63(12): 20. June 20.

An estimate of the area shaded by residual hardwoods can be obtained by multiplying the basal areas in hardwoods by 1.4.

MCCULLEY, R. D.

Gunning for loblolly pine cones. Southeast. Forest Expt. Sta., Research Note No. 40. July.

A .22 rifle, equipped with telescopic sight, proves effective tool for collecting pine cones on trees which cannot be cut or climbed.

MCCULLEY, R. D.

Natural regeneration of loblolly pine in the southeastern Coastal Plain. Southeast. Forest Expt. Sta. Station Paper No. 26. 14pp. Aug.

A review of recent research in natural regeneration of loblolly pine, and recommendations for applied management.

MCCULLEY, R. D.

The seed-tree system: a summary of recent research in loblolly pine. The South. Lumber Jour. 57(8): 20, 22, 90-91. Aug.

A summary of recent research on seeding characteristics, cone-crop forecasts, seed-crop stimulation, seedbed preparation, and their coordination for the practical management of loblolly pine.

MERGEN, F.

Leaf pigments in five conifers in relation to apparent light tolerance. (Abs.) Assoc. South. Agr. Workers Proc. 50: 171.

This paper reports results of a study which was carried out to find a possible relationship between the amount of chlorophyll and other pigments in the needles and the apparent light tolerance of some conifers.

MERGEN, F.

Gum yield in longleaf pine inherited. Naval Stores Rev. 62(47): 18-19. Feb. 21. Also, with title Gum yields in longleaf pine are inherited, Southeast. Forest Expt. Sta. Research Note No. 29. Jan. Also in AT-FA Jour. 15(5): 14, 17. Feb.

First evidence that gum-yielding capacity is inherited is obtained from 17-year-old progeny test.

MERGEN, F.

The story of some unique trees. South. Lumberman 186(2329): 72, 74. April 15.

For the first time in history, mature cones were collected from rooted slash pine cuttings. In addition to being a historical "first," it represents one step closer to the goal of developing high-yielding pines for naval stores.

MERGEN, F.

Selection and breeding of slash and longleaf pine at Lake City, Florida. (In English.) Zeitschrift für Forstgenetik und Forstpflanzenzüchtung 2(6): 126-129. Frankfurt, Germany. Also, with title Selection and breeding of longleaf pine, in Naval Stores Rev. 63(7): 12-14, 23-26. May 16.

Research in species improvement of longleaf and slash pine at the Lake City Research Center includes tree selection, vegetative propagation, and controlled breeding. Preliminary results are discussed.

MERGEN, F.

First mature cones collected from rooted slash pine cuttings. AT-FA Jour. 15(10): 8-9. July.

Beginning with the rooting of cuttings in 1943-44, this is the first recorded production of mature cones from rooted slash pine.

MERGEN, F.

Air-layering as a possible method to reproduce selected slash pine. Naval Stores Rev. 63(21): 19, 20. Oct. 17.

Long known to horticulturists as a method of reproducing cultivated plants, air-layering has been used successfully for the first time on slash pine.

MERGEN, F., and POMEROY, K. B.

Some practical suggestions for better slash pine seed. The South. Lumber Jour. 57(11): 88-89. Nov.

Organizations with extensive reforestation programs might improve seed quality in slash pine by improving selected natural stands of vigorous, even-aged, cone-bearing trees. Method of improvement and hints for seed collection are discussed.

NELSON, T. C.

Honeysuckle is a serious problem. Forest Farmer 12(11): 14-16. Aug. Also in Southeast. Forest Expt. Sta. Research Note No. 41. July.

Best hope for reducing honeysuckle invasion, common throughout the Piedmont, is the use of weed-killers. Degree of shade and time of year are probably more important than chemical concentration or dosage.

OSTRANDER, M. D., and ENGLERTH, G. H.

Hardwood log grading scale stick improved. Northeast. Forest Expt. Sta. Research Note No. 24. Sept.

Illustrates a hardwood log grading stick based on the Forest Service Standard Hardwood Log Grades. Describes how to use it.

OSTROM, C. E.

More and better trees: the activities of the Committee on Southern Forest Tree Improvement. South. Lumberman 186(2326): 35-36. March 1. Also, with title Accomplishments of the Committee on Southern Forest Tree Improvement, in Naval Stores Rev. 62(51): 14-15, 26-28. March 21. Also, with title Recent developments in the southern forest tree improvement program. (Abs.) Assoc. South. Agr. Workers Proc. 50: 115-116.

Discussion of the function, accomplishments, and plans of the Committee on Southern Forest Tree Improvement.

POMEROY, K. B.

Cooperative research--key to the future. Forest Farmer 12(5): 19, 38. Feb.

Selected examples of collective effort among federal, state, and industrial agencies demonstrates that cooperative research in Florida pays high dividends.

POMEROY, K. B.
Tree improvement--its potentialities. Forest Farmer 12(11) 8-9, 11. Aug. Also in The Unit 48: 25-27. July. Also in Paper Trade Jour. 137(6): 18-19. Aug. 7.

Preliminary results show that the value of forest trees can be increased by genetic control of inherited characteristics. Best returns in forest tree improvement will probably be achieved by combined efforts of silviculturists working with environmental factors and geneticists working with inherited factors.

POMEROY, K. B.
Forest research progress. Naval Stores Rev. Internatl. Yearbook, 1953: 77-80. Aug. 31.

Summary of the research program in naval stores, forest management, genetics, and protection at the Lake City Research Center.

POMEROY, K. B.
Research in tree improvement at Lake City. TAPPI 36(11): 147a-150a. Nov.

Forest managers who remove undesirable trees, leave only the best trees for regeneration, and plant seedlings from the best available local parentage can reap the benefits of eugenic forestry while waiting for the deferred benefits of controlled breeding.

POMEROY, K. B.
Better trees for tomorrow. Naval Stores Rev. 63(20): 19, 21-22. Sept. 19. Also in AT-FA Jour. 16(2): 18. Nov.

Propagation and controlled breeding, proven tools of the horticulturist and agronomist, are now being used in developing superior strains of longleaf and slash pine.

ROTH, E. R.
Sprout oak decay. Amer. Forests 59(1): 35, 43. Jan.

An account of the manner in which stump-sprout oaks become butt-rotted early from the parent stumps and from the cut stubs of companion sprouts. Sprouts arising at or near the ground line on parent stumps seldom contract stump rot, while sprouts arising more than an inch or two above ground line usually become decayed.

SCHOPMEYER, C. S.
A review of some physiological aspects of oleoresin flow from slash and longleaf pine. (Abs.) Assoc. South. Agr. Workers Proc. 50: 172.

Two theories are advanced to explain the mechanism of oleoresin transfer from epithelial cells into resin ducts.

SCHOPMEYER, C. S.
The characteristics of a high-gum-yielding tree. Naval Stores Rev. 63(12): 12-13. June 30. Also in AT-FA Jour. 15(10): 4. July. Also in Southeast. Forest Expt. Sta. Research Note No. 39. July.

The factors controlling gum flow in slash pine appear to be size of resin ducts exposed by chipping, number of ducts per square inch of fresh face, viscosity of gum, and exudation pressure. If these factors are inheritable, trees rating high on all four can be developed by controlled breeding.

SCHOPMEYER, C. S.
Removable gutters: key to better conservation of naval stores timber. South. Lumberman 187(2345): 112-115. Dec. 15.

By using special gutters attached with double-headed nails, jump-butting may be eliminated, with an estimated increase in stumpage value of over $400 per crop.

SHEPHERD, W. O.
Effects of burning and grazing flatwoods forest ranges. Southeat. Forest Expt. Sta. Research Note No. 30. May. Also, with title Effects of burning and grazing, in Naval Stores Rev. 63(12): 17, 20. June 20.

Summary of 7-year study of burning longleaf-slash pine forest range at intervals of 1, 2, and 3 years; ecological trends with and without grazing, chemical composition of forage, diet and weight gains of young cattle, fuel accumulation, tree reproduction. General effect of tree cover on understory vegetation. (Based on Ga. Coastal Plain Expt. Sta. Bul. 51 by Halls, et al.)

SHEPHERD, W. O., and DILLARD, E. U.
Best grazing rates for beef production on cane range. N. C. State Agr. Expt. Sta. Bul. 384. 23pp. Oct.

Results of a 3-year study of six intensities of summer grazing on highly productive range in eastern North Carolina; effects on cow and calf gains, range productivity, fire hazard. Maximum long-term benefits realized at 55-60 percent utilization of cane foliage.

SHEPHERD, W. O., SOUTHWELL, B. L., and STEVENSON, J. W.
Grazing longleaf-slash pine forests. U. S. Dept. Agr. Cir. 928. 31pp. Nov.

Results of a 5-year study of breeding herds on "wiregrass" range in southern Georgia; range use as influenced by burning; also range plants and forage quality, number and size of calves, factors limiting herd productivity, influences of fall and winter herd management practices.

SHIPMAN, R. D.
Poisoning small-diameter hardwoods with the Cornell tool. Southeast. Forest Expt. Sta. Research Note No. 38. July.

Eighteen months after treatment with Ammate applied with a Cornell tool, only one-quarter of the small hardwoods studied were still living. The least effective kill occurred with dogwood and hickory.

SMITH, W. R.
Utilization of wood waste. Conserv. Congress Proc., N. C. Board of Conserv. and Devlpmt. 1: 107-110. 1952, pub. 1953.

A description of the amount of wood residue available in North Carolina and some of its possible uses.

SMITH, W. R., MILLER, R. H. P., BROWN, O. A., and WELDON, N. W.
The development of an automatic wood-burning furnace for curing brightleaf tobacco. Southeast. Forest Expt. Sta. Station Paper No. 23. 41pp. April.

Describes the construction and operation of an automatic wood-burning furnace as developed after 8 years of experimental research. Fully illustrated.

SOUTHEASTERN Forest Experiment Station
Annual report for 1952. Southeast. Forest Expt. Sta. Station Paper No. 22. 42pp.

TODD, A. S., Jr.
Forest products marketing in an area. In Research in the Economics of Forestry, pp. 336-343. Charles Lathrop Pack Forestry Foundation, Washington, D. C.

Procedure to be used in making a study of the distribution of forest products in an area.

TODD, A. S., Jr.
Small sawmills as buyers of southern pine timber. Jour. Forestry 51(3): 169-172. March.

How small sawmill operators buy timber in the North Carolina Piedmont.

TODD, A. S., Jr.
Sawmill and logging residues in the South Carolina Piedmont: problems and methods of salvage. Southeast. Forest Expt. Sta. Station Paper No. 31. 32pp. Nov.

Detailed information on the residue volumes available, their location, concentration, and current market value.

WAHLENBERG, W. G.
Use of a short-handled planting hoe in the Appalachians. Tree Planters Notes 14: 6-8. April. Also in Southeast. Forest Expt. Sta. Research Note No. 26. Jan.

This short-handled hoe used in Montana and Idaho proves to be an effective tree-planting tool in the Southern Appalachians.

WAHLENBERG, W. G.

Modifying nursery stock to fit modern planting methods. Tree Planters Notes 14: 4-5. April.

Nurserymen are encouraged to grow and grade their stock to suit modern planting tools as well as to meet site requirements.

WAHLENBERG, W. G.

Three methods of rehabilitation for depleted Appalachian hardwood stands. Jour. Forestry 51(12): 874-880. Dec.

A 20-year comparison of no cutting, clear-cutting, diameter-limit cutting, and quality selection show that selection is a suitable method for preparing depleted hardwood stands for management.

WAHLENBERG, W. G.

A 37-year test of thinning Appalachian white pine. South. Lumberman 187(2345): 180-183. Dec. 15.

Management in the form of six intermediate cuttings, beginning when the plantation was 20 years old, increased the total yield in stumpage by $200. Nearly one-third of the total wood yield on the thinned plot came from thinnings. Sawtimber yields are 50 percent greater on the thinned than on the unthinned area.

WENGER, K. F.

The sprouting of sweetgum in relation to season of cutting and carbohydrate content. Plant Physiology 28(1): 35-49. Jan.

Sprouting vigor, expressed as height or weight of 1-year-old sprouts, showed pronounced correlation with date of cutting. Number of sprouts did not follow a seasonal trend, and is closely correlated with stump diameter. Size and number of sprouts is apparently not dependent on carbohydrate content.

WENGER, K. F.

How to estimate the number of cones in standing loblolly pine trees. Southeast. Forest Expt. Sta. Research Note No. 44. July.

Instructions for making a binocular estimate of cone crops, including conversion of the binocular count to total number of cones.

WENGER, K. F.

Preharvest release of loblolly pine seed trees will increase seed supply at harvest. Southeast. Forest Expt. Sta. Research Note No. 45. July.

Choosing seed trees and releasing them 3 to 5 years before the harvest cut will increase the seed cast at harvest.

WENGER, K. F.
The effect of fertilization and injury on the cone and seed production of loblolly pine seed trees. Jour. Forestry 51(8): 570-573. Aug.

Application of fertilizer at the rate of 25 and 50 pounds per tree significantly increased cone production of 25-year-old loblolly pines. Forty-year-old trees did not respond to treatment. Half-girdling with a knife produced no increase in cone crop. Treatments did not significantly affect percentage of defective cones, number of seeds per cone, or percentage of defective seed per cone.

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ADDENDA

The following 1952 items did not appear in the Station's 1952 Bibliography:

HALLS, L. K., SOUTHWELL, B. L., and KNOX, F. E.
Burning and grazing in coastal plain forests. Ga. Coastal Plain Expt. Sta., Univ. Ga. Bul. 51. 33pp. Nov. 1952.

Results of a 7-year study of vegetation and cattle responses to burning frequency (1-, 2-, and 3-year intervals vs. no burning) in longleaf-slash pine forests of Georgia; ecological trends and chemical composition of forage species, diet and weight gains of young cattle, fuel accumulation, and tree reproduction. Also, general relationship between amount of tree canopy and herbaceous understory.

HOOVER, M. D., and LUNT, H. A.
A key for the classification of forest humus types. Soil Sci. Soc. Amer. Proc. 16(4): 368-370. Oct. 1952.

Previous keys based on northern forest conditions have heretofore proven unsatisfactory elsewhere. For the first time the authors have presented a key to forest humus types that is developed for the entire country.

SHEPHERD, W. O.
Forest ranging beef. N. C. Agr. Expt. Sta. Research and Farming 10(4): 11. Spring 1952.

Current forest grazing research in the cane type in North Carolina; cattle management, forage management, grazing capacity.

TOOLE, E. R.
Two races of *fusarium oxysporum f. perniciosum* causing wilt of *albizzia* spp. Phytopath. 42(12): 694. 1952.

Describes two forms of mimosa wilt fungus, one attacking *A. julibrissin* and one attacking *A. procera* (Puerto Rico).

Agriculture-Asheville